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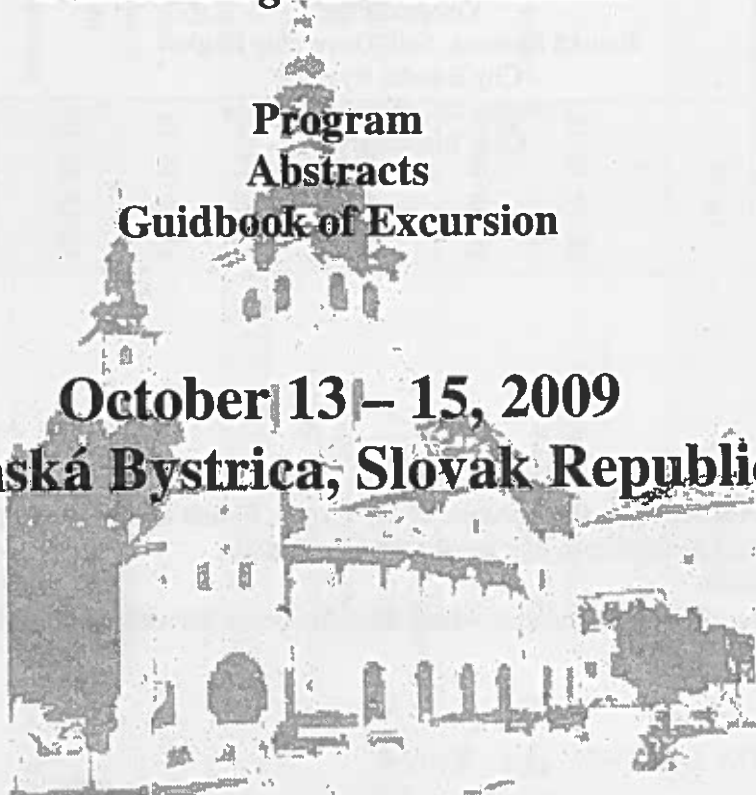
**10th Anniversary Conference
of the Czech, Polish and Slovak Paleontologists**

FOSSILS • DARWIN • EVOLUTION

*with the invitation
of other Central European
Paleontological Associations*

**Program
Abstracts
Guidbook of Excursion**

**October 13 – 15, 2009
Banská Bystrica, Slovak Republic**



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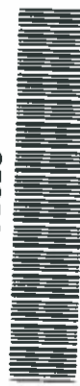
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PROGRAM OVERVIEW

Thursday - 15/10	Wednesday - 14/10	Tuesday - 13/10
Breakfast	Breakfast	8:00-10:30
Post-conference field trip	Mesozoic section (convenor J. Michalík) Room A	8:30-9:50
departure 8:00	Coffe Break	9:50-10:15
	Mesozoic section (convenor Z. Vašíček) Room A	10:15-11:15
	Advanced and actualistic methods in paleontology (convenor J. Páľy) Room B	10:30-12:50
	Lunch	13:00-14:00
	Vertebrate section (convenor P. Holec) Room B	14:15-15:00
	Cenozoic section (convenor K. Holcová) Room A	15:00-15:40
	Coffe Break	15:40-16:00
	Cenozoic section (convenor R. Pipík) Room A	16:00-18:00
		16:00-18:00
		18:00-19:00
		19:00

ABSTRACTS

Two examples of faunal interactions on Carboniferous-Permian spores and plants

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The generic name *Discinispora* Wang, Zhang, Bek et Pfefferkorn was originally attributed to the spores with an operculum-like structure that have been found in a permineralized Noeggerathialean cone from Permian of Inner Mongolia, China. Subsequently it was observed that up to three round and smooth openings can occur in different positions on the surface of a single spore. In light of the new observations, the previous interpretation as an operculum can not be sustained. An interpretation implicating insect punch-and-sucking activity was suggested for these round structures. This new interpretation makes it necessary to withdraw the original diagnosis and the taxon. The insect-inflicted damage now is assigned to the ichnotaxon *Circulipuncturites discinisporis* Labandeira, Wang, Zhang, Bek et Pfefferkorn under the rules of the ICZN, rather than those of the ICBN that typified the insect damaged host-plant spore.

A new reproductive organ is described from macerations obtained from tuff deposits within the Pennsylvanian (Bolsovian) age Radnice Member of the Kladno Formation at the Doubrava locality in the Pilsen Basin of the Czech Republic, and named *Echinosporangites libertite* gen. and sp. nov. The remains comprise dispersed sori with each sorus consisting of 4–5 annulate sporangia. Sporangia possess four different types of cells and three specialised trichomes. *In situ* spores are characterized by a prominent labrum, irregular loaf-like sculpture of the distal surface, and may resemble some specimens of the dispersed spore genus *Schopfites*. As the reproductive organs of *E. libertite* occur in a dispersed state, its parent plant remains unknown. The specialized trichomes in *E. libertite* appear to have contributed to sporangial dehiscence, and the opening mechanism may have been facilitated by faunal-interaction.

Palaeontological Collections in the Slovak Museum of Nature Protection and Speleology in Liptovský Mikuláš

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A paper deals with general information about palaeontological collections of the Slovak Museum of Nature Protection and Speleology in Liptovský Mikuláš. Some collections have a high historical value as they come from the Liptov Collection founded by Ján Volko-Starohorský in 1904. A total number of the collection fund is 100,853 items, from which the Museum owns and manages 4,203 palaeontological items that represent valuable material coming from the Paleozoic to Quaternary. The oldest fossils come from the years 1904–1905 e.g. *Mollusca* and *Osteichthyes* that have not been determined on the species level up to now. A part of findings comes from a cave environment such as osteological materials of bats, *Martes martes*, *Panthera spelaea* from Prepoštská Cave in Bojnice, and the Bear Cave in the Western Carpathians Mts. The findings of *Ursus spelaeus* represent an important part of the fund. The bones and teeth were found in the caves of the Lower and Western Tatras Mts., the Slovak Paradise, and the Slovak Karst. Fragments of *Hyaena spelaea* from the Čertova pec Cave, Radošiná as well as fragments of *Mastodont* from several localities belong to more valuable specimens in the Museum.

Early Cretaceous aptychus assemblages from the Bersek Hill (Gerecse Mts., Hungary)

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Aptychi, somewhat controversially interpreted as lower jaw elements of ammonites, are well known from Lower Cretaceous strata at many European localities. Despite their potential utility for biostratigraphy and paleobiogeography, their occurrences in Hungary have not been studied in detail previously. Here we report the first taxonomic, biostratigraphic and paleobiogeographic results from an aptychus-bearing Valanginian to Barremian section on Bersek Hill (Gerecse Mts., Transdanubian Range, Hungary).

Altogether 418 aptychus specimens were obtained in the early 1960's, together with 2750 ammonoids and nearly 150 belemnites, carefully collected bed-by-bed. Integrated stratigraphic data now also include nannoplankton biostratigraphy. Fifty-two of 56 successive levels yielded aptychi within the stratigraphic interval from the Late Valanginian Peregrius Zone to the latest Hauterivian Ohmi Zone. *Lamellaptychus* is the only genus identified in the material, represented by six species and six subspecies. One species appears to be new but the quality of material does not allow its formal description.

The stratigraphic distribution of the aptychus species agrees well with that observed in the Western Carpathians and in the Betic Cordillera (Rio Argos section). Aptychi do not occur in the Barremian strata. Their local disappearance at the Hauterivian-Barremian boundary is interpreted to reflect a change in ammonoid assemblages, in turn correlated with the Faraoni event, a regional if not global oceanic anoxic event.

Similarities with the aptychi faunas of the Western Carpathians may be explained by paleogeographic proximity of these areas. However, an even higher similarity is observed to assemblages from the Betic Cordillera, suggesting paleobiogeographic affinities between these units along the Early Cretaceous western Tethyan margin.

A new species of *Eucalathis* (Brachiopoda: Chlidonophoridae) from the Upper Cretaceous seep deposits of Omagari, Hokkaido, Japan

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Although not known from the vent/seep environments today, brachiopods were members of the chemosynthesis-based communities in the past. They usually constituted monospecific associations rich in specimens. The oldest records of brachiopods from chemosynthesis-based associations are those from the Silurian of Russia and Morocco where lingulate and atrypid brachiopods were found, respectively. Since Devonian, rhynchonellides dominate in the hydrocarbon seep associations. The best known are two genera with a worldwide but disjunctive distribution: Upper Devonian *Dzieduszyckia* and Early Cretaceous *Peregrinella*, both characterized by large size and coarsely ribbed ornamentation.

Terebratulides are much less common in the ancient seep deposits, therefore the occurrence of the micromorphic terebratulides in the Campanian hydrocarbon seep deposits of Omagari, Hokkaido, Japan is of great interest. The monospecific assemblage is represented by a new species of the chlidonophorid genus *Eucalathis*. The specimens are small, with maximum observed length 5.7 mm, ornamented by numerous fine, beaded ribs. The loop is of a chlidonophorid type, with sub parallel to slightly divergent descending branches that are narrowing anteriorly. In the ornamentation of the numerous fine ribs the specimens from Japan bear similarity to three living species, Indo-Pacific *E. murrayi* (Davidson, 1878), eastern Atlantic *E. tuberata* (Jeffreys, 1874), and Caribbean *E. cubensis* Cooper, 1977 but differ in having higher beak and wider loop. The new species represents the oldest and single Mesozoic record of the genus. Today, *Eucalathis* has a worldwide distribution, except for the northern Pacific area, and is represented by 13 species with a wide bathymetric range from 185 to 3870 m. In the fossil record, *Eucalathis* is very rare and has been so far reported from the Eocene of Eastern Coast of America and Miocene of Italy.

Spirellea seeds from the Iharkut locality (Upper Santonian, Hungary) and their classification based on type material (Upper Cretaceous, Czech Republic)

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Iharkut locality is situated in the Bakony Mts, Western Hungary. At the fossil site several vertebrate fossils were unearthed. The frequent occurrence of the studied plant mesofossils in the bone-bed type layer. The Upper Santonian age of the bone-bearing sediments is based on palynological examinations and on paleomagnetic age determination.

The *Spirellea* KNOBLOCH et MAI genus is a dominant form of the examined mesofossil flora, from the 255 seeds found, 132 belong to *Spirellea*.

Most specimens have well-preserved structural features, which enabled to confirm or confute the taxonomic classification of the genus. Stenomaceae seeds have particular structure morphology, characterized by linear striation and divided endopleura. This study was the first to show and examine the divided endopleura of *Spirellea* with scanning electron microscope.

Recent studies confirm that *Spirellea* morphogroup belongs to Stenomaceae family. Today's representatives of Stenomaceae require subtropical and humid climate. Usually, they live in floodplain grove forests. Ecological needs of the nearest living relatives confirm that bone-bed type layers were deposited at subtropical climatical conditions.

Type material of Knobloch Collection in the Czech National Museum (Prague) was re-examined for the species determination. A new morphological character, the external reticulation of the holotype and some lectotypes of *Spirellea terebecensis* KNOBLOCH et MAI was observed. For determining the species not only the ordinary paleontological methods were applied, but also statistical methods, multiple data analysis, and principal component analysis were used. Results of the analyses have been interpreted as the Hungarian material contains two species, *Spirellea terebecensis* KNOBLOCH et MAI and *Spirellea pragensis* KNOBLOCH et MAI.

After the taxonomical identification, stratigraphic questions were examined. The Iharkút material is well preserved, so redeposition can be excluded and the material can be used for stratigraphic purpose. The genus *Spirellea* is a Late Cretaceous age angiosperm. *S. pragensis* was used as an index fossil of the Cenomanian, but its Upper Santonian occurrence requires the omission from the index fossils. The other possibility is to use the entry of *S. pragensis* for identification of the Cenomanian, but this solution is problematic, because it is difficult to clearly detect any hiatus in terrestrial sediments.

Microfauna of Párnica Marl Formation from Lúčky-Hlboké (Choč Mts.)

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Studied locality is situated by Lúčky village in Hlboké valley, Choč Mts. Outcrop within pelagic Párnica Marl Formation is represented by grey to brownish, laminated marlstones and marly limestones sometimes bioturbated, with scarce terigenous admixture. Organodetrritic limestones are present within this succession. This formation belongs to the Patric paleogeographic domain.

Marlstones contain well-preserved microfauna with planktonic foraminifera. Dominant are genera *Globigerinelloides* and *Blefuscinia*. Relatively scarce is the occurrence of *Hedbergella* and *Lilliputianella*. *Lilliputianella globulifera* (KRETCHEMAR and GORBACHIK) has been determined as seldom along the section but dominant in a single case. According to index species the age of the mentioned sediments could be determined as Late Aptian, limited by the occurrence of *Globigerinelloides ferreolensis* (MOULLADE), according to zonal scheme of Robaszynski & Caron. Growth deformations and bioerosion marks are relatively common among planktonic foraminifera. Part of the samples contains more or less common

representatives of benthic foraminiferal genera: *Rhizammina*, *Hyperammina*, *Ammodiscus*, *Glomospira*, *Dorothia*, *Spiroplectinata*, *Sabaudia*, *Nodosaria*, *Pseudonodosaria*, *Dentalina*, *Lenticulina*, *Fronidicularia*, *Discorbis* and *Anomalina*.

Microstructure of the marls and marly limestones is foraminiferal biomicritic/biomicrosparitic (foraminiferal wackestone) with local accumulations of recrystallised foraminifera (foraminiferal packstone/grainstone). Scarce clasts with micritic microstructure (mudstone) and peloids have been identified.

Dominant microfossils are planktonic foraminifera. Benthic foraminifera are scarce. Nannocoenids are more or less common. Other fossil content is very scarce, represented by fragments of thick- and thin-shelled bivalves, echinoderms, ostracods, calcareous dinoflagellates (*Cadosina semiradiata semiradiata* WANNER), *Gemeridella minuta* BORZA and MIŠÍK, sponge spicules and recrystallised detritus and/or biotritus.

For the organodetritic limestones, intrabiopelagic structure (grainstone), only scarce as intrabiopelagomikrospartic (wackestone/packstone), is typical. Microfacies contain foraminifera, sometimes echinoderms - foraminifera. An uncommon association of benthic foraminifera in these limestones is represented by *Ammodiscus* sp., *Glomospira* sp., *Glomospira* cf. *urgoniana* ARNAUD-VANNEAU, cf. *Mayncina bulgarica* LAUG, PEYBERNÉS and REY, *Haplophragmoides joukovskyi* CHAROLLAIS, BRÖNNIMANN and ZANINETTI, *Montsalevia salevensis* CHAROLLAIS, BRÖNNIMANN and ZANINETTI, cf. *Vercorsella scarsellai* (DE CASTRO), *Charentia nana* ARNAUD-VANNEAU, *Trochammina* sp., *Sabaudia minuta* (HOFKER), *Neotrocholina* sp., *Citaella?* *favrei* CHAROLLAIS, BRÖNNIMANN and ZANINETTI, *Meandropsira bancilai* NEAGU, *Meandropsira washitensis* LOEBLICH and TAPPAN, *Spiroloculina cretacea* REUSS, *Gaudryina* sp., *Dorothia oxycona* (REUSS), *Lenticulina* sp., *Fronidicularia* sp., *Anomalina* sp., *Valvulineria* sp., Miliolids and large „Textularids“. Other fossil content is represented mainly by fragments of echinoderms and thick-shelled bivalves (with microborings), bryozoa, *Pieninia oblonga* BORZA and MIŠÍK, scarce calcareous dinoflagellates, (*Cadosina semiradiata fusca* WANNER, *Cadosina semiradiata olzae* NOWAK, *Colomisphaera heliosphaera* (VOGLER)), *Ostracoda* div. sp., calcareous algae, aptychi, scarce filaments, gastropods, *Globochaete alpina* LOMBARD, cf. *Didemnooides moreti* (DURAND DELGA), ?serpulids and other debris of shallow water origin.

Development of the forest vegetation in the Českomoravská vrchovina Upland in the Late Glacial and Holocene (Czech Republic)

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In connection with the geological mapping on the territory of Českomoravská vrchovina Upland, the research of organic sediments linking up the study of the former localities on the territory of Žďárské vrchy Hills and Železné hory Mts. started.

The palynological investigations in this territory were carried out almost at the beginning of introduction of pollen analysis into the methods used in geology (Fírbas 1927, Rudolph 1927, Salaschek 1935, Puchmajerová 1943, Kneblová-Vodičková 1961, 1966, 1970); later Rybníček continued in the southern part (Rybníček et Rybníčková 1961, 1968, Rybníčková 1974). The palaeogeoeological research of peat complexes in the Českomoravská vrchovina

Upland provides possibility of monitoring the forest vegetation development during the Late Glacial (15,000/13,000-10,250 BP) and the Holocene (10,250 BP-recent).

The author of the presented paper deals with the research of the northern part of the Protected Landscape Area of the Žďárské vrchy Hills and the Železné hory Mountains. The new palaeoecological results were gained from the deepest peat land of the Velké Dářko peat bog (Břízová 2004, 2006a), the transitional peat land of Zlatá louka peat bog by Podmoklany (Břízová 2006b) and fenland in the Čerhovka brook floodplain (locality Bezděkov).

The modified method of acetolysis described by Erdtman (1954) was used at laboratory treatment after one-day maceration in HF (Faegri et al. 1964). As a medium for microscopic biological preparations a mixture of glycerine – ethyl alcohol – distilled water was used. Drawing of the pollen diagrams was carried out in the program POPLAL (Walanus et Nalepka 1999). The zoning according to Firbas (1949, 1952) was used at classification and reconstruction of vegetation development. The newly worked out localities of the Velké Dářko peat bog, Zlatá louka peat bog and Bezděkov confirmed and complemented the previous investigations by the new results.

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Earliest world known occurrence of *Lacerta viridis* (Sauria, Lacertidae) from the Lower Miocene of central Europe

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Earliest world record of the extant species *Lacerta viridis* is described from the Lower Miocene of Central Europe. The fossils come from greenish, calcareous marls and limnic clay

silt of the Oltngian zone MN 4 of the locality Dolnice near Cheb in the Czech Republic. The sediments are interpreted as marginal, riparian facies. The material consists of frontal bones of two ontogenetic growth sizes. Their morphology is identical to that in the species *L. viridis*. However, this material is much older than previously described specimens. Bolkaý (1913) described fossil bones from the Upper Miocene sediments (Pannonian) of Hungary and Rumania, which he referred to the contemporaneous species *Lacerta viridis*. However, Estes (1983) demonstrated that the oldest undeniable remains of this species are from Upper Pliocene of Hungary and Sicily. The oldest known remains of *Lacerta cf. viridis* were described on the basis of several isolated dentaries and maxillae from the late Miocene (MN 11) localities of Kohfidisch in Austria (Tempfer, 2004) and Polgárdi in Hungary (Venzel, 2006). The great majority of *L. viridis* fossils, however, are documented from the Late Pliocene (Ivanov, 2007) and Pleistocene of Europe (Bonfiglio, 2004). Therefore, the new material expands our knowledge of its evolution by providing new data on its spatial and temporal ranges and morphology.

Late Eocene micromorphic brachiopods from Austria

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Eocene brachiopods were described from several countries of Europe (e.g. England, France, Belgium, Germany, Spain, Italy, Hungary, Romania, Poland, Ukraine, Bulgaria), but until now they were almost unknown from Austria. Recently I have studied several Late Eocene samples from two boreholes of the Upper Austrian Molasse Zone (Helmsberg-1 and Perwang-1) and a surface locality of the Waschberg Zone (Reingrubberhöhe). Rasser et al. (1999) attributed the studied Helmsberg and Perwang samples to nannoplankton zones NP 19-20 and Reingrubberhöhe is also regarded Priabonian by Zágöršek (2003).

All samples were originally collected by Kamil Zágöršek for Bryozoa studies (Zágöršek 2001, 2002, 2003). As he used a chemical method and treated the samples in acetic acid for several weeks, the preservation of brachiopods is exceptional even for the smallest juvenile specimens. The three localities yielded altogether nearly 2500 small-sized, so-called micromorphic specimens (Helmsberg-1: 561, Perwang-1: 1398, Reingrubberhöhe: 536). The taxonomic composition of Perwang-1 and Helmsberg-1 samples is very similar: dominant genus is *Terebratulina* (74.3% and 76.3%, respectively). The second most frequent brachiopods are small and smooth terebratulides in Perwang samples (18.6%), while *Platidia* in Helmsberg samples (9.8%). All the other genera (*Argyrotheica*, *Orthothis*, *Megathiris*) are insignificant in both localities. However, Reingrubberhöhe shows significantly different taxonomic composition. The most frequent genera are *Argyrotheica* (65.3%), which is insignificant in the boreholes and *Lacazella* (25.7%), which is absolutely missing at the former two localities. Small and smooth terebratulides (5%), *Megathiris* (2.8%) and *Terebratulina* (0.9%) belong to the less important faunal elements at Reingrubberhöhe.

On the basis of the bryozoan studies Zágöršek (2001, 2002, 2003) interpreted Helmsberg-1 and Perwang-1 samples as belonging to cool water and/or deep-water basin with active upwelling of cold water. The sediments deposited at the margin of continental shelf or perhaps on the continental slope (depth of at least 200 m and perhaps as much as 500 m).

According to him, the Reingrubberhöhe fauna originally lived in a shallow environment and has been redeposited in more deep-water sequences. These interpretations are confirmed by brachiopod results. The taxonomic composition of the Late Eocene shallower and deeper water brachiopod faunas is similar to Recent Mediterranean ones (Logan 1979; Logan et al. 2004). Here *Argyrotheca*, *Megathiris* and *Lacazella* dominate in shallow waters (ranging down to about 200 m), while *Gryphus*, *Terebratulina*, *Platidia* and *Megerlia* characterise the eurybathic species, which are more typical of the bathyal zone. It means that more or less the same depth differentiation among brachiopods as in Recent seas was already present in the Late Eocene ones.

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The European Upper Cretaceous Nautiloidea (Cephalopoda)/ palaeogeographic distribution – preliminary report

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Upper Cretaceous nautilids are represented by approximately 90 species in 15 genera. From this number about 43 species belonging to 7 genera are known from Europe. These species inhabited European epicontinental seas (basins). Some species show only local appearance, other species can be found in several basins and some of them even expanded outside of Europe, for example to Africa or India. The appearance of these species changed through time and space. Transgressive events probably influenced a connection between different basins and made possible migration of some species. The species diversity shows the influence of cold boreal and warm Tethyan waters.

Current studies including the palaeogeographical distribution of Upper Cretaceous nautilids, e.g. only in the European standards are critically needed. Major studies by Kummel (1956), Wiedmann (1960) and Shimansky (1972) deal just partly with this topic (problematic).

The migration of nautilids is the next open issue. It is very important to pay attention to the absence of plankton stage providing an easier distribution (Landman, 1988), binding to

the maximal depth of 800m (Wray et. al., 1995; Westermann, 1973) and the necroplanktonic dispersal (Reyment, 2008; Wani and Ikeda, 2006) of shells for the interpretation of nautilids distribution. Also important is the still not clear interpretation of phylogeny and relatively high conservativeness of the shell morphology of some species.

These are preliminary results of recent study of Upper Cretaceous nautilids of the European epicontinental basins.

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Deltocymatoceras galea (Fritsch, 1872) the remarkable Upper Cretaceous Nautilid (Cephalopoda)

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Frič (1872) established the new species *Nautilus galea* on specimens from the Middle/Upper Turonian of the Bohemian Cretaceous Basin (BCB). Later this species was assigned by Kummel (1956) to the genus *Angulithes*, by Shimansky (1875) to the genus *Deltoidonautilus* and by Frank (2007) to the genus *Deltocymatoceras*. Kabamba (1983) described one specimen from the Turonian of the Madagascar as *Deltocymatoceras* n. sp. This specimen is conspecific with *D. galea* from the BCB. The genus *Deltocymatoceras* is disputable himself (etc. Wilmsen, 2000). It can be defined as a combination of two genera *Cymatoceras* and *Angulithes*. Genus *Deltocymatoceras* is represented just by three species: *D. leiotropis* (Schlüter, 1876), *D. rugatus* (Fritsch, 1872) and *D. galea*. The type species with radial ribbing on the surface and ventral keel is *D. leiotropis*. The ribs are on the ventral side traversed by a thin keel, which is not crossed. *D. rugatus* is characterised by relatively broader ribbing and again by a keel. This species is notable for the ribs visibly crossing the keel. *D. galea* is mainly remarkable for changing immensely his features during the ontogenesis. Juvenile specimens can be easily confused with specimens of the *Eutrephoceras*. It is mainly due to the simple suture, depression shape and smooth shells. Bigger specimens are ornamented just by remarkable growth lines. On the biggest specimens, probably adults, there is a noticeable keel on the ventral side of the living chamber. The shape of the whorl cross

section is in the part of a living chamber obtusely sagittate. This keel and the whorl cross shape are typical for the genus *Angulithes*. Another feature of the "adult" specimens is a strong ribbing in the aperture area, which takes up to one fourth of the living chamber. The keel does not continue to the ribbing but ends before the ribbing is noticeable. The keel is with a high probability an original feature because of its symmetry. It is not a secondary feature in this case. The secondary keel can originate, for example, during lateral pressure when the living chamber bursts or by the lateral deformation of the cast. These secondary keels are easy to identify due to their asymmetry.

Due to his features *D. galea* finally integrates three different genera *Eutrophoceras*, *Angulithes* and *Cymatoceras* in one species. This species can be probably indicated as an intermediate stadium between these genera, mainly between *Cymatoceras* and *Angulithes*. Still it is important to reevaluate diagnosis of some genera, especially *Cymatoceras*.

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The colour pattern and the shell microstructure of some Upper Triassic and Lower Jurassic bivalves from the Western Carpathians

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During the last fifteen years of the field research rarely preserved bivalve shells with original colour pattern were found. For the first time colour pattern of the Upper Triassic bivalve species from the Rhaetian Fatra Formation (*Propeanussium* (*Parvanussium*) *schaftaeutli* (WINKLER, 1859), *Plagiostoma punctatum* (J. SOWERBY, 1815), *Plagiostoma* sp. 1, 2 and *Modiolus minutus*) and Lower Jurassic species (*Gryphaea arcuata* LAMARCK, 1802) are described. The study of internal microstructure showed that in all cases the shells are strongly recrystallized or, in one case, partly silicified. All aragonite parts are replaced by calcite and outer originally calcitic shell layer is very compressed. In this outer calcitic layer the colour pattern is preserved. Only left valves of the species *Propeanussium* (*Parvanussium*) *schaftaeutli* (WINKLER, 1859) were found with preserved colour pattern consisting of hundreds of small and short black lines processing from the umbonal area to the

ventral region. In the ventral part they formed pattern like the letter W resembling the pattern known in *Entolium discites* from the Muschelkalk of the Germany (HAGDORN, 1995). The pattern of species *Plagiostoma* sp. 1, and *Plagiostoma punctatum* (J. SOWERBY, 1815) is of dark brown to black colour formed by bunches of distinctly separated bands. The alternation of thicker and thinner bands is typical, but where they crossed with the growth concentric lines they have wavy process. In the case of *Plagiostoma punctatum* (J. SOWERBY, 1815), the colour bands of the same colour process parallel on the top of the radial ribs. Only when they are thicker than the ribs, they occur in the grooves between the radial ribs. The flat valve of the species *Plagiostoma* sp. 2 is covered by three thick dark coloured bands. The shell of the *Modiolus minutus* (GOLDFUSS, 1834) is predominantly of dark to black colour, only the growth lines on the anterior side are without pigmentation.

Among Lower Jurassic bivalves typical and worldwide-distributed species, *Gryphaea arcuata* LAMARCK, 1802 is the only one with preserved colour pattern (although the shells are intensively silicified). In this case only the flat right valve is of dark to black colour, sometimes missing on the concentric growth bands. This can be explained by the mode of living of this species. The specimens layed down with their left, strongly incurved valve in the sediment and were protected from the chemical corrosion of the sea water, hence the periostracum in the right flat valve was thicker. The thicker periostracum comprised more much organic matrix in comparison to the left valve, to protect the shell of the organism. It is supposed, that the sediment/water boundary was near or slightly below the boundary/contact of the right/left valve.

The shells were tested under the UV-light, but no light reaction or colour change of the colour bands was observed. This can support the theory that melanin can be present in the preserved shells and upon the concentration gives black to brown to red and yellow colour of the shell.

In all cases where shells were found, sedimentary record indicates rapid burial.

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A Giant Early Miocene Sunfish from the North Alpine Foreland Basin (Austria) and its Implication for Molid Phylogeny

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Three extraordinarily well-preserved skeletons and skeleton parts of an Early Miocene sunfish are described. These unique fossils allow a precise osteological description of one of the largest if not the largest sunfish (320 cm) known so far and represent one of the largest teleost fossils of the Cenozoic Era. This new sunfish genus is the sister-taxon of the extant Mola+Masturus clade and, together with these two genera, forms the sister-clade of Ranzania.

The radiation of modern-type sunfishes therefore already had occurred during Oligocene times. The finding from the earliest Miocene narrows the gap between the oldest known Eocene primitive sunfish and the Middle and Upper Miocene records, which are all referable to extant genera. *Austromola* is introduced as a new genus of the family Moliidae; *Austromola angerhoferi* is described as a new species.

New Miocene taxa (*Pirumella gigantea* n. sp. and *Pirumella gigantea granulata* n. sp.) of calcareous dinoflagellate cysts from the Vienna Basin.

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Two new taxa belonging to the *Pirumella* genus are described from Sarmatian (late Middle Miocene) sediments from samples of the Jakubov boreholes J 64 A2, J 29 and JZ 46 (Vienna Basin). Samples were derived from the Skalica Formation, rich in fossil remnants: nannoplankton, planktonic and benthic foraminifers, molluscs, ostracods, fish skeletons and oolithes, and also flora fragments and pollens. The age of sequence was determined by foraminiferal assemblages belonging to Porosonion granosum Zone and nannofossil local Zones (Kováč et al. 2006).

The newly introduced taxa: *Pirumella gigantea* n. sp., and *Pirumella gigantea granulata* n. sp. dominated over *Pirumella edgarii* and not so frequent forms of *Calcicarpinum*, *Cylindratulus*, *Dimorphosphaera* and *Posoniella* genus.

In all 12 samples, the study showed the dominance of morphotypes with an oblique ultrastructure of two types of needle-like crystallites belonging to *Pirumella* genus. Most cysts are spherical in shape. The single-layer cysts are very thick (thickness of the layer is from 10 to 20 µm). Archeopyle is circular to irregularly circular (type A).

These low diverse associations of calcareous dinoflagellate cysts represent a flora of warm-water shallow marine (lagoon) environment (with maximum depth 15 m), with fluctuation of salinity and oxygen content. The obtained results and paleoecological interpretation based on calcareous dinoflagellate cysts distribution coincide very well not only with those shown by planktonic and benthic foraminifera, and nannoplankton.

Calcareous nannofossils of the Late Badenian (Early Serravallian) of the Western Carpathians Neogene sequences - „state of art“

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The remains of calcareous nannoplankton (unicellular marine algae) provide one of the best records of global changes preserved in marine sediments. Calcareous nannofossils reflect sensitively climatic and oceanographic changes are important for paleoecology and above all

for age determination. They are very useful also for resolution of stratigraphical and paleoecological tasks in the Late Badenian sedimentary record.

The Badenian (Langian/Early Serravallian) can be subdivided on the base of calcareous nannofossils into the Early and Late Badenian. The Central Paratethys Late Badenian regional substage corresponds with the regional stage Konkian in the Eastern Paratethys and with the lower part of the Serravallian of the Mediterranean standard stage. The Late Badenian spans the time of 13.59 – 12.7 Ma. Late Badenian of the Western Carpathian can be characterized by normal marine paleoenvironment and at the end of this time interval by brackish conditions due to separation from the Mediterranean (Kováč et al. 2007).

The Late Badenian sediments are correlated with calcareous nannoplankton standard Zone NN6 - Discoaster exilis. The lower boundary of the Late Badenian is identical with the Langhian/Serravallian boundary and corresponds with the boundary between NN5/NN6 Zones of calcareous nannoplankton. The nannofossil event of the LAD *Sphenolithus heteromorphus* is also tied to this level and correlated with FAD of the *Velapertina indigena* (planktonic foraminifera). FAD *Triquetrorhabdulus rugosus*, *T. rioi* are secondary nannofossil marker species for the lowermost part of the Late Badenian. In lower part of NN6 Zone deep-water associations with acme *Discoaster variabilis* (indicating outer shelf) or shallow water with acme *Sphenolithus abies* (indicating inner shelf) occur. Sediments of the upper part of the NN6 Zone are impoverished of discoasters and other typical marine forms. The Upper Badenian sedimentation in the East Slovak Basin ended with hyposaline deposits containing the foraminiferal association with *Ammonia* and poor nannofossils of the NN6 Zone. The upper boundary of the Late Badenian can be defined according to calcareous nannofossils by LCO of *Calcidiscus premacintyreii* and by appearance of *Calcidiscus macintyreii* and *Calcidiscus pataecus* together with FAD of benthic foraminifera *Anomalinoides badeniensis*.

The presence of nannofossil assemblages of the NN6 Zone and foraminiferal assemblages of the Bolivina - Bulimina Zone during the Late Badenian (Early Serravallian) in all basins of the Western Carpathians indicates the similarity of marine environment. The water mass cooling to the latest Badenian was proved on the base of benthic foraminifera (Kováčová et al. 2008; Kováčová & Hudáčková 2009) and was supported also by distinct horizon with abundant cold-water nannofossil species *Holodiscolithus macroporus*.

The next analysis of calcareous nannofossils of the Late Badenian calcareous nannofossils research will incorporate HRS method, precise quantitative approach, and application of statistical methods by definition of the boundaries. The stratigraphical correlation with forams will be very beneficial. The accent will be put on monitoring the event of LAD *Sphenolithus heteromorphus* in connection with beginning of the foraminiferal Bulimina – Bolivina Zone and using of morphometry by taxonomical precision of the *Calcidiscus* species in context of the Badenian/Sarmatian boundary in the Western Carpathians.

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Successions of foraminifera and calcareous nannoplankton assemblages during the Early Badenian transgression in the Western Carpathians (Central Paratethys)

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The studied late Early Badenian transgression can be correlated with the global sea-level cycle TB2.4 or Lan2/Ser 1 and with the Mid-Miocene Climatic Optimum (Hohenegger et al. 2008). The interval is biostratigraphically characterized by absence of *Helicosphaera ampliaptera*, FO of *Orbulina* followed by LO of *Praeorbulina*. The transgression was studied in the South Slovakia Basin and in the Carpathian Foredeep.

In the South Slovak Basin, the Badenian transgression started with the late Early Badenian cycle after hiatus including the Late Karpatian and the lower part of the Early Badenian (*Globigerinoides bisphericus* is missing). The event started with deposition of suspension-transported foraminiferal tests indicating storm events. Horizon with suspension-transported tests is followed by horizon with indigenous *Cibicides*-assemblage (passive suspension feeders). These assemblages characterize areas of strong bottom currents. Then epifaunal foraminifera prevail in the marginal part of basin (indicators of sea-grass meadows), lagenids prevail in the central part of basin. Successive flooding of coastal swamps can be interpreted from the decrease of the marsh-humid elements in palynospectra (Holcová et al. 1996).

Older lowermost Badenian cycle correlated with TB2.3 cycle of global sea-level changes was recorded in the Carpathian Foredeep. This cycle is characterized by stormy events connected with massive postmortem transport of shallow-water faunas to the deeper part of the basin (Spezzaferri, 2004). The late Early Badenian transgression started with appearing of calcareous nannoplankton assemblages characterized by bloom of *Reticulofenestra minuta*. It may indicate penetration of the warm-water (Rögl, 1998), oscillations of salinity or near-shore environment. Colonization of the bottom by Foraminifera started with *Cibicides*-assemblage. Though no indices of the postmortem transport were recorded in this horizon, high P/B-ratio, planktonic foraminiferal assemblages dominated by deep-water *Globorotalia* spp. and occurrence of deeper-water taxa (*Hansenica*, *Pullenia*, *Oridorsalis*) do not correspond with the expected paleobathymetrical interpretation based on the other organic groups (molluscs, echinoderms) and sedimentology. The penetration of deep-water foraminifera to the shallow water as well as high P/B-ratio may be explained by specific condition at the beginning of the transgression (?nutrient). These assemblages are replaced by assemblages dominated by epifaunal species (indicators of sea-grass meadows).

Oxygen isotopic composition varies during the transgression event from the -1.0 to -0.5‰ what may indicate a freshwater influx. The carbon isotopic values are low (-3.5‰), whereas other data from the Early Badenian of the Central Paratethys show positive values.

Conclusions

The Central Paratethys Miocene flooding events started with horizon with transported fauna indicating storm events. It may indicate influence of marine transgression on local climate conditions. After stabilization of stenohaline condition, the bottom is colonized by suspension feeders indicating strong bottom currents. Specific conditions enable penetration of deeper water taxa to the shallow part of basins.

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Multivariable statistical method and potential application of non-controlled learning neural networks in paleontology

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There are some potential methods that provide an opportunity for getting solution for paleontological or geological problems which can be traced back to the different grouping problems, for example revision of species and pattern recognition. These methods are multivariable statistical and neural networks.

The point of the research is the analysis of shell of snail diversity by the use of biometric methods and its treatment by multivariate statistic methods. The factor analysis highlights the most important biometric features at each locality. The hierarchic cluster analysis shows the relation between the localities. The morphological classes have been separated with the help of discriminant analysis. The functions shown by the discriminant analysis provide possibility to assign new specimens into the morphological groups.

These morphological groups created by statistics correspond to the groups separated by the internal structure of the shells.

There is a new potential method in the paleontology, the neural networks, which is derived from biological systems and since the processes in the nature, similarly to the active organism, is complicated systems, their study or their modelling using neural network can be done by an analogue way.

Self Organized Map (SOM) is a kind of algorithm in the field of non-controlled learning neural networks, which may be a potential method for solution of geological or paleontological pattern recognition problems or in the analysis of geological scale problems.

SOM is primarily used as a dimension-reduction tool and as an abstraction process to represent data points with fewer representatives. This mapping preserves the original topology, i.e. it forms a locally correct projection while its distance mapping globally is a dear consequence of the local projection. A SOM consists of neurons organized on a regular low-dimensional (i.e. its dimension is lower than that of the original variable space) grid. Each neuron is a d-dimensional weight vector where d is equal to the dimension of the input vectors. These neurons control the classification using a suitable distance.

The advantages of the algorithm contrasted with a multivariable statistical classification method are as follows: it can reveal non-linear contact; the grouping process does not depend on the spatial position of the first two input vectors chosen during the reduction phase.

Generic assignment of some Miocene callianassoid mud shrimps from Western Carpathians

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Remains of callianassoid mud shrimps belong to the most frequently preserved decapod crustaceans fossils. However, because of the delicate nature of most of the cuticular surfaces, fossil callianassoids are represented mainly by isolated chelae. Thus the fossil material usually lacks the diagnostic characters of extant taxa, which include the design of pleopods and maxillipeds, the dorsal carapace architecture and the form of the abdomen. Extensive literature therefore uses the genus *Callianassa* as a collective taxon that should not be synonymized with the extant taxon *Callianassa*. The first work which attempted to provide more realistic relationship between fossil and recent taxa was by Manning & Felder (1991) who recognized several morphological characters on the first pereopods, which mirrored the supposed taxonomic position within the callianassoids. Their work stimulated reassessment of several fossil taxa to the biologically defined genera. The characters of big taxonomic importance are on merus and carpus of the chelipeds. Feldmann et al. (2005) argued that using only propodus of the major cheliped is very difficult and merus is usually needed to achieve generic placement. It seems that the only exception is the genus *Glypturus*, which has characteristically shaped propodus with several (usually three) spines on its upper margin. The reexamination of the type material of *Callianassa muniti* Brocchi, 1883 from the middle Miocene (Badenian) of Hungary and *C. fraasi* Noetling, 1885 and *C. subspinosa* Glaessner, 1929 from the upper Eocene of Southwest Africa, Egypt and Hungary has revealed that these taxa can be reassigned to the genus *Glypturus* on the basis of their propodi. Moreover the comparative material of *C. muniti* contains also well-preserved carpi and meri (Müller, 1984) which confirms the new assignment. Similarly the material of *Callianassa brocchi* Lörenthey, 1897 and *C. pseudorakosensis* Lörenthey in Lörenthey & Beurlen, 1929 from the middle Miocene (Badenian) of Hungary and Slovakia allows reassigning the former taxon to the genus *Neocallichirus* and the latter one to *Calliax*. Meri, carpi, propodi and dactyli are known from these taxa and within *C. pseudorakosensis* it is also possible to observe sexual dimorphism. Using the characters on merus and carpus as the main taxonomic tool helped also with the systematic placement of new material from Early Miocene (Karpatian) strata of Vienna basin as *Callianopsis* sp. nov., which is currently under description. Characters of dorsal carapace supporting the generic assignment were also observed. Some 60 specimens of *Callianopsis* sp. nov. exhibit strong sexual dimorphism and intraspecific variation in the nature of propodi.

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Neogene evolution of the genus *Varanus* (Platynota; Varanidae) in Europe

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Superfamily Varanoidea represents diversified platynotan group comprising extant families Helodermatidae (North America), Lanthanotidae (Borneo Island), and Varanidae (Asia, Africa, and Australia). The genus *Varanus* (family Varanidae; 56 species, 9 subgenera - Böhme [2003]) is recently subdivided into 3 groups on the basis of mtDNA (Ast 2001): African species, Indo-Asian group (with two distinct clades A + B), and Indo-Australian group. MtDNA sequences indicate the close relationship with extant *Lanthanotus* (e.g. Ast 2001). However, the inclusion of extinct taxa into cladistic analyses makes the systematics of varanoid lizards more complicated; thus, some authors (Lee 1997) consider the extinct *Saniwides* from the Late Cretaceous of Mongolia to be a sister clade to the genus *Varanus* but the most recent analyses (e.g. Conrad 2008) consider *Saniwa*, namely *Saniwa ensidens* from the middle Eocene of Wyoming, to be a sister clade to the genus *Varanus*.

Only three extinct species of the genus *Varanus* are recently supposed to be valid in Europe and Africa: *Varanus rusingensis* (Early Miocene, 19.9 to 19.5 Ma, MN 3, Kenya) being the oldest known *Varanus* closely similar to extant African species (Clos 1995), *Varanus hofmanni* (Middle Miocene, MN 6, Germany and France; possibly from the Early Miocene of Germany and Spain and the Late Miocene of France, Spain, Austria, Hungary, and Moldova), and *Varanus marathonsensis* (Pliocene, MN 15-MN16, Greece, Hungary, and Turkey; Late Pleistocene of Italy) (e.g. Estes 1983).

The Early Miocene *Varanus* sp. from the karst joints in Mokrá-Western Quarry (Moravia, Czech Republic) are among the oldest known European records of this genus. New discoveries of varanid lizards from Moravia are of a particular importance because numerous cranial bones have been discovered, being largely unknown in other Early Miocene specimens. Moreover, discovered bones enable the reconstruction of nearly the whole skull.

Detailed comparative studies of Miocene varanids from Mokrá-Western Quarry with overwhelming majority of extant forms supports the presumption (Ivanov 2007) that *Varanus* sp. from Mokrá-Western Quarry was closely related to the extant representatives of diversified Indo-Asiatic varanids. This is especially true for the *Varanus bengalensis* group (subgenus *Empagusia* comprising *Varanus bengalensis*, *V. nebulosus*, *V. dumerilii*, *V. flavescens*, and *V. rudicollis* - sensu Böhme 2003) as it was documented by discoveries of several bones of neural exocranium and endocranium and neurocranial replacement + membrane bones.

It is probable that the genus *Varanus* evolved well before the beginning of the Miocene. The oldest well known representatives, *Varanus rusingensis* (Rusinga, Kenya) a *Varanus* sp. (Mokrá-Western Quarry, Czech Republic) indicate that the genus *Varanus* was split at least into the African and Indo-Asiatic forms as early as at the end of the Early Miocene. Although the oldest known *Varanus* comes from Africa, the morphological studies support the assumption that origin of this genus is most probably Asiatic. Asiatic origin of varanids from Mokrá-Western Quarry is not surprising because some other representatives of herpetofauna being almost surely of Asiatic origin are known also from other localities in Central Europe. However, preliminary comparison of varanids from Moravia with those from the Early and Middle Miocene of Germany indicate that there were several distinct forms of the genus *Varanus* inhabiting Europe. The different forms might have immigrated into Europe in

several distinct migration waves. The detailed comparative osteology within all fossil varanids will be a subject of the future research.

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A rich ichnofossil assemblage from the Frasnian (Upper Devonian) deposits at Andoma Hill, Russia (Onega Lake, Russia)

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The Andoma Hill fossil site is an approximately 3 km long series of outcrops along the lake coast, which is located at the eastern coast of the Lake Onega, in Vytegra district of the Vologda government, Russia. These outcrops are locally strongly influenced by glacial deformations.

As object of geological importance, the Andoma Hill has attracted the attention of geologists for several centuries: the samples of fossils have been collected since the beginning of the 19th century. Yet scientific research in ichnology begins only with description of trace fossils by S. Yengalichev in 2003. Studies of the sections by members of joint expeditions of St. Petersburg University and University of Latvia from 2002 to 2007 provided remarkable fossil material for further exploration (Ivanov et al., 2006).

Recently, the Devonian succession of Andoma Hill was divided into three lithostratigraphic units (Ivanov et al., 2006). Their age determination was based on the vertebrate assemblages. The lowermost Pavlikovskaya Formation was dated as the Upper Givetian. The age of the middle Andoma Formation was defined as the Lower Frasnian, the upper Klimovskaya Formation – as probably the Lower-Middle Frasnian. An attempt of reconstruction of sedimentary environment was suggested for those formations.

The richest assemblage of the trace fossils is observed in the middle part of the Andoma Formation. On the surface of very fine-grained sandstone, as epi- and hyporeliefs, such

ichnogenera has been discovered: *Cochlichnus*, *Cruziana*, *Diplocraterion*, *Glockerichnus*, *Lockeia*, *Paleophycus*, *Planolites*, *Rusophycus*, *Skolithos*, *Teichichnus*, *Trepichnus*, and *Undichna*. In the upper part of the Andoma Formation different assemblage of trace fossils is observed. It is found in fine to medium grained sandstones, is much less diverse and contains only *Diplocraterion* and *Skolithos*. This assemblage possibly indicates the presence of the *Skolithos* ichnofacies typical for the shallow water environment. *Skolithos*-like burrows are rather widely distributed in the section, usually associated with layers of silty and clayey deposits, which shows that various trace makers inhabited the sea bottom almost permanently during the Andoma time. Yet the intensity of bioturbation indicates that the colonization intervals were usually short, presumably due to the rapid sedimentation.

The data on distribution of ichnofacies supplement and approve the interpretation of sedimentary data: the sediments of Andoma Formation have formed in the tidal zone, in the sublittoral and littoral zone.

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Stratigraphic investigations of the Świniarski Żleb - Kopy Sołtysie area (Lower-Middle Jurassic, Krizna Unit, Tatra Mts., Poland) - preliminary studies

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The Bajocian to Pliensbachian succession composed of the carbonates, marly-carbonates and shales of the thickness of 200 meters has been studied recently in the northern-western part of the slope of Kopy Sołtysie (West Tatra Mts.).

Litologically, the rocks are characterized by the insignificant facies diversity and they are attributed to the Sołtysia Marlstone Formation. The lower part of profile is represented by black, dark-grey, spotty limestones and marls interbedded with the black shales – of the Krzywan Limestone Member. Above this sequence there are the olive-green marls represented by the Świniarka Marlstone Bed that is overlain by the thick sequence of the grey, spotty limestones and marls – Skalnite Marlstone Member. Skalnite Marlstone Member is overlain by the dark-grey, spotty limestones interbedded by the marls – called Podspad Marlstone Member. This member is overlain by the black and dark-grey marly shales known as - Podskalnia Shale Member. At the top of the studied profile there are grey, spotty, siliceous limestones – Łomy Limestone Member.

Podskalnia Shale Member has yielded rich ammonite faunas determined by R. Myczyński, such as: *Graphoceras concavum* (Sowerby, 1825), *Graphoceras cf. rudis* (Buckman, 1889), *Graphoceras decorum* Buckman, 1888, ?*Graphoceras* sp., *Brasilia* ex. gr.

bradfordensis (Buckman, 1881), ?*Brasilia* sp., *Ludwigia* cf. *crassa* Horn, 1909, *Ludwigia* sp. The ammonite fauna indicates the Late Aalenian age of the Podskalnia Shale Member. The age of the Skalnite Marlstone Member has been dated on the Early Toarcian, based on the single occurrence of the ammonite of *Haugia navis* Dumortier, 1874.

Development of the Eocene deposits in the Polish Tatra Mountains

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Upper Lutetian–Priabonian deposits in the Tatra Mountains (south Poland) were laid down on the erosional surface that truncates the tectonized Mesozoic rocks. The sequence of the Eocene deposits commences with conglomerates consisting of bedrock clasts. The conglomerates are overlain by sandstone built of grains of disaggregated Triassic dolomites with variable admixture of quartz grains containing numerous bioclasts, mainly large benthic foraminifera: nummulites (dominated by *Nummulites brogniarti* d' Archiac & Haime), discocyclinids. The sandstone thickness ranges from 2 m to 80 m.

Further up the foraminiferal limestones rich in larger foraminifera, in particular nummulites (*Nummulites brogniarti*, *N. puschi* d' Archiac & Haime, *N. perforatus* (Montfort), *N. striatus* (Brugueri) □), *N. incrassatus* de la Harpe) were deposited. These sediments are followed by marls with numerous orthoherminids (*Dysocyclina ephippium* (Schlotheim), *D. pratti* (Michelin), *Asterocyclina stella* Gümbel) and planktonic foraminifera: *Globigerinatheka index* (Finlay), *G. mexicana* (Cushman), *Subbotina senii* (Bekmann), *Dentoglobigerina tripartita* (Koch). The age of the sediments on the basis of the foraminiferal assemblages has been estimated as Late Bartonian–Early Priabonian. The thickness of the complex is up to 10 m. At the top of the sequence occur sediments of Priabonian age, based on the occurrence of the benthic foraminifera: *N. fabianii* (Prever), *N. incrassatus*, *N. chavannesi* de la Harpe, *Heterostegina multifida* (Bieda), *Spirocypus granulatus* (Boussac), *Discocyclina dispansa sella* d' Archiac. The Priabonian sediments occur as conglomerates with numerous bioclasts in some profiles, in other profiles as limestone with red algae and rhodoids. The thickness of these deposits is up to 100 m.

According to composition of foraminiferal assemblages, planktonic foraminiferal ratio, flattening of Nummulitidae and occurrence of red algae, several microfacies types have been distinguished: nummulitic packstone, orthoherminid packstone/wackestone, wackestone/packstone with nummulites, orthoherminids, red algae and locally miliolids and red algal bindstone. The poor preservation of outcrops and scarce data from boreholes make it impossible to precisely reconstruct the spatial arrangements of the facies.

Generally, the amount of fauna fossils and calcium carbonate content increase upward from the conglomerate to the limestone while the amount of detritic material decreases in this interval.

The Upper Lutetian to the Priabonian sediments show a transgressive sequence. The conglomerates and sandstones filled the pre-transgressive relief and almost levelled the uneven basement topography. The limestones sequence corresponds essentially to carbonatic facies with benthic foraminifera deposited in a shallow platform base in middle to outer ramp areas.

The sedimentation of Priabonian conglomerates over the marls supports the idea of an active synsedimentary tectonic activity during the Eocene time.

3D neurocranial visualization in the Mongolian oviraptorid dinosaur *Conchoraptor*

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The oviraptorid specimen, ZPAL MgD-I/95 (Fig. 1), (Institute of Palaeobiology of the Polish Academy of Sciences, ZPAL), was collected by members of the Polish–Mongolian Palaeontological Expedition in 1971 at the Hermin Tsav locality (Upper Cretaceous) in the Gobi Desert, Mongolia.

The snout and the braincase of the specimen were scanned at the CT Facility of the NMR Unit of the First Faculty of Medicine, Charles University in Prague, Czech Republic with 1mm interslice spacing.

Transverse CT images were used for 3D reconstruction of the endoneurocranial cavity (ENC) and bones and their pneumatic sinuses embedded in matrix. The endoneurocranial contours were outlined using the Ellipse program (ViDiTo Systems, Slovakia). A volumetric model of the *Conchoraptor* endoneurocranium was created by plotting the contours in successive planes of the 3D data set. The surfaces were constructed by detection of triangulated isosurfaces, properly coloured and combined in the VRML model. The model was constructed and the images of the models were made by rendering the resulting 3D constructs in Ellipse program.

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Occurrence of the Tertiary opalised chestnut near Povrazník village (Slovakia)

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Detailed study of polished section of particularly opalised wood relicts with visible vessels of fossil tree in pyroclastic material of Strelníky formation, formed by redeposited

lapill and lapill-pemza tuffs (Dublan 1993, Ďud'a a Pauliš 2006) between Povrazník and Ponická Huta villages, discovered chestnut on the slopes Poľana stratovolcano in Late Tertiary – Miocene, in the Middle Sarmatian.

Vascular tissue is created by remarkable large vessels, which are in the zone of early wood in many columns; their tangential diameter is from 150 to 300 µm. They have oval cut on the transversal section. Latewood vessels are several times thinner, with diameter from 36 to 125 µm, and they are ordered individually or in groups which have radial, diagonal, often branching continuance. Perforation of vessels is simple. Pitting on the vessels walls is alternate. Vessels in heartwood create thin walled thylois. Storage materials are deposited in ray-parenchyma and axial parenchyma. Speciality of chestnut-wood is also a very low frequency of axial parenchyma which is in other ring-porous woods represented richly. Axial parenchyma occurs in strands as apotracheal diffused and also as paratracheal - scanty vasicentric. An important diagnostic sign for chestnut-wood is a form and size of ray parenchyma cells. Rays are homogenous, uniseriate. They reach 115 to 300 µm high, which is 5 to 30 parenchyma cells. Mechanic tissue is mostly formed by libriform fibre, but from evolutionary transitional tissues occurs also fibrous vasicentric tracheids. The length of fibres reaches 600 to 1570 µm. Libriform fibres are thin-walled, which is the reason of lower density of wood (ρ_0 530-590 kg.m⁻³) than in other ring-porous wood species (oak-tree, locust-tree, elm).

Based on several studies (Húsenica 1981, Chovanec 1991, Dublan 1993) it is possible to suppose according to observed character of climatic conditions for lower to Middle Sarmatian time in environs of polygenic Poľana stratovolcano (about from 12,4 up to 13,6 mil years) within periodic catastrophic precipitation fallen tree trunks were flushed away and gradually covered by deposits of mud and/ or volcanic material. Buried trunks could be locally exposed to activity of high temperature solutions – hydrotherms and gas exhalants which were situated on the periphery of stratovolcano. Silica oxide solutions with Fe, Mn, and other elements totally penetrated tree trunks and precipitated in different colour varieties of opal. Origin structure and texture of wood of trunks were truly kept. It is presumed that silicified wood originated by weathering of volcanites in alkaline environment inducing high solubility and leaching of silica, which resulted in its high mobility. The alkaline environment developing under conditions of volcanic weathering leads to the concentration of alkali metals and earths. The decomposing plant remnants served as geochemical microbarriers on which silica precipitated in the result of pH changes probably in the form of colloidal gels. Amorphous silica precipitating in plant tissue acquires orientations preserving many fine morphological details of plant tissue even in the case of partial recrystallization into opal CT (Forgáč et al. 1990).

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Palaeontological and mineralogical studies of the Cenomanian-Turonian interval in the Nowe Rybie section, Subsilesian Unit, Polish Outer Carpathians

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Palaeontological studies based on foraminifers, calcareous nannoplankton and trace fossils combined with mineralogical data allow recognition of the Cenomanian-Turonian succession in the Nowe Rybie section.

The lower part of the studied section (2.6 m) contains pelagic and hemipelagic grey to light grey and greenish grey, thin-bedded, locally silicified spotty marlstones, which are intercalated with rare thin beds and laminae of medium-grained sandstones and rare mm-thick laminae of mudstones and marly claystone shales. The marlstones contain sand and silt grains of quartz, light mica, glauconite, carbonates, bioclasts of foraminifers, rare echinoderm spines and dispersed carbonized plant detritus. They are distinguished as the “fucoid marls” or “spotty marls” by Skoczylas-Ciszewska (1960). The spots are cross sections of trace fossils, including *Alcyonidiopsis*, *Chondrites*, *Palaeophycus*, *Planolites*, *Taenidium*, *Thalassinoides*. The trace fossil assemblage indicates fluctuations of oxygenation within sediment from the oxic zone in the lower part to dysoxic zone in the upper part.

In the lower part of the fucoid marls the foraminiferal assemblage is dominated by planktonic *Rotalipora reicheli*, *R. greenhornensis*, *R. appenninica*, which indicates the Middle Cenomanian (Machaniec et al., 2005). In the upper part of the fucoid marls foraminifers are absent or very scarce. The planktonic foraminifers are represented here by small forms of *Hedbergella*, *Globigerinelloides*. Benthic foraminifers include agglutinated long-ranging *Ammodiscus*, *Recurvoides*, *Trochammina*, and poorly-preserved, corroded long-ranging calcareous forms of the genera *Lenticulina* and *Marginulina*. This part of the section contains long-ranging Cretaceous calcareous nannoplankton taxa, including *Prediscosphaera* sp., *Zeughrabdotus* sp., *Eprolithus floralis* and *Broinsonia enormis* (the latest two are known since the Aptian and Albian, respectively). The dominant calcareous nannoplankton taxon is *Watznaueria barnesiae*. Trace fossils and benthic foraminifers indicate worsening of ecological conditions during deposition of the analyzed part of the fucoid marls.

The fucoid marls are overlain by a poorly exposed layer (28 cm) of light greenish mudstones, which are covered by 20 cm-thick of black non-calcareous claystone shales with a green claystone lamina in the upper part. Unfortunately, this part of the section is tectonically disturbed and probably incomplete. The black shales contain high amounts of amorphous organic matter (mixture of vitrinite and liptinite). This part of the section is devoid of foraminiferids and trace fossils. It represents an anoxic event that can be referred to the Bonarelli horizon of the Ocean Anoxic Event 2 (OAE-2).

The black-shales are covered by red and variegated, partly silicified marlstones (2 m) which contain abundant silt and fine sand grains. The marlstones are intercalated with two ferrous layers, which contain cryptocrystalline silica and Fe oxides and display stromatolitic and oncogenic-like laminations. The lower part of red and variegated marlstones numerous radiolaria and planktonic foraminifer *Hedbergella* sp. Probably, this part of the section represent the lowest Turonian. The upper part of the marlstones can be dated to the upper part

of Lower Turonian on the basis of the occurrence of calcareous nannoplankton species *Quadrum gartneri*, which is the index species of the UC-7 Zone.

Upper part of the section is occupied by a 5.5 m thick package of creamy hard, partly silicified, bedded marlstones, which are known as the Žegocina Marl (Skoczylas-Ciszewska, 1960). The lower part of the Žegocina Marl contains calcareous nannoplankton species *Marthasterites furcatus*, the first occurrence of which is noted in the Tethyan province at the base of the UC-9 Zone of the middle Turonian.

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Graptolite assemblages across the upper Katian faunal diversity maximum in the Prague Basin (Králuv Dvůr Formation, Czech Republic)

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The Králův Dvůr Formation is one of key lithostratigraphic units in the Prague Basin. It is of the upper Katian age (i.e. Královodvorian or lower Ashgillian in regional or historical usage, respectively). Its lower limit is marked by conspicuous change in sedimentation, traceable in the whole "Mediterranean Province". Black shale lithofacies was succeeded by fine greenish mudstones with micritic carbonate nodules. Change in lithology is associated with a prominent faunal change. The Aegiromena-Drabovia fauna of underlying units was replaced by low- to moderate-diversity associations, assigned to Foliomena Fauna. Faunal diversity further increased in the uppermost part of the formation. This peak of diversity is, however, followed by a dramatic impoverishment in response to global climatic changes. Upper limit of the Králův Dvůr Formation is marked by a thin bed of glaciomarine diamictite.

Graptolite fauna is quite rare to even absent in the majority of the Upper Ordovician successions of the north-western peri-Gondwana. The Králův Dvůr Formation with its graptolite fauna represents an exception among graptolite-bearing upper Katian successions in this area. Uncommon normalograptids and dicellograptids have been reported in the Králův Dvůr Formation since the end of 19th century although they have been occasionally collected from the mid-19th century (e.g. Scharý's collection housed in Boston now contains several specimens from Kosov). "*Glyptograptus teres* Perner, and some, so far undetermined biserial rhabdosomes are known from the lower part of the formation; two dicellograptid species (*Dicellograptus laticeps* Štorch and *Dicellograptus cf. morrissi* Hopkinson) associated with rare plegmatograptids ("*Plegmatograptus chuchlensis* Přibyl"), early normalograptids (*Normalograptus angustus* (Perner)), and some undescribed climacograptids and pararetiograptids come from the middle and upper parts of the formation. *Normalograptus ojsuensis* (Koren' et Mikhaylova) *sensu* Štorch (1989) is known from the topmost part of the formation. Observed patterns of graptolite occurrence reflect global climatic changes along with specific local conditions.

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First results of study of Upper Triassic limestones of Hallstatt-facies on selected outcrops of the Silica Nappe

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The present study focuses on the Upper Triassic pelagic limestones belonging to the Hallstatt series of the Silica Nappe, geographically situated in the Slovak and Drienčany Karst areas.

The limestones outcropping in the woods below the quarry has been recently studied at the "Nový lom" locality. They represent grey to light pink fine-grained lower Norian limestones changing upward into spotted pinkish grey limestones without cherts. The base of profile is built by weakly thick-bedded limestones with thickness of beds decreasing upward. Channell et al. (2003) consider these limestones to represent the Massiger Hellkalk. They were deposited during the Lower Norian. The overlying limestones, exposed in the Nový lom, are uppermost Lower Norian or lower Middle Norian in age.

Slightly detritic limestones, pink to grey without cherts, were found in the "Drienčocká pustatina" locality. Their bedding is unclear, which might be caused by a fold. According to Gaál (1982) they are classified like "lamellibranchiata packstones" with abundant pelets and bivalvian shells. Based on the presence of conodonts, they have been deposited during the Upper Tuvalian (*Gondolella noah* HAYASHI and *G. nodosa* HAYASHI Gaál (l.c.)). The overlying beds represent the Lower Norian period.

The locality "Kamenný jarok" comprises two partial outcrops: Kamenný jarok A and Kamenný jarok B. The Kamenný jarok A is built by light-grey fine-grained to muddy limestones with dispersed organic detritus and weak bedding gradually changing into bedded light-grey to pink crinoidal limestone. More upward, there are present fine-grained reddish-grey, spotted pink muddy limestones with indications of nodularity and stylolites. They contain only small amounts of detritus, cherts have not been found. The part Kamenný jarok B represents the transgressive contact of Hallstatt limestones with Egerian Budikovany Beds. The profile is filled by light-grey bedded muddy limestones with dispersed organic detritus and grey cherts with repeated layers of lumachella. Based on conodont microfauna *Metapolygnathus abneptis abneptis* HUCKRIEDE and *M. abneptis spatulatus* HAYASHI Gaál (1982), the limestones in lower parts of these profiles are believed to be the Lower to Middle Norian in age. Their overlying beds were deposited in Alaunian - Lower Sevatian based on presence of *M. posterus* KOZUR and Lower to Middle Sevatian in their uppermost parts based on *M. bidentatus* MOSHER.

The outcrops in Budikovany are built in the lower parts of the profile by light grey to greyish-pink muddy limestones with organic detritus and light as well as dark lithoclasts. The bedding is unclear. Bedded grey limestones with red nodules and cherts are exposed above. They are followed by pink muddy limestone and grey fine-grained, almost muddy limestone. Cherty layers are also present in the outcrop. Above these beds there is a layer of shaley marly

limestones gradually changing into greyish-yellowish muddy limestone with cherts and brown spots. Kozur & Mock (1974) reported from this locality presence of conodont *Misikella longidentata* KOZUR-MOCK. In the area above the profile there is a small outcrop built by three beds of light-grey muddy limestone.

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Palaeoclimate Interpretation at the Locality Veľká Čausa (Early Miocene, Western Carpathians) based on CLAMP Method

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Terrestrial palaeoclimates can be estimated from fossil macrofloras using the observation of different physiognomic characteristics of leaves. Individual morphological data (leaf size, shape and margin configuration), for each taxon, reflect climatic preferences and can be used for palaeoclimatic reconstruction and ecological interpretation. Different predictive models demonstrate definite relationships both of the climatic variables and leaf characters, but the precision of these relationships varies depending upon the statistical model applied to the data. Application of the CLAMP (Climate Leaf Analysis Multivariate Program) method to the fossil flora assumes that if climatic parameters can explain physiognomic variation, then variation can be used to predict climatic parameters. The attributes used in CLAMP are the scores of the 31 different leaf character states taken from more than 20 species of woody dicots in each vegetation site. Multivariate data set should describe leaf physiognomy more accurately, and thus reveal more precise relationship between physiognomy of woody dicot flowering plants and climate.

The locality Veľká Čausa is situated in the Upper Nitra depression of the Handlová-Nováky brown-coal basin about 3 km north of Veľká Čausa in an outcrop exposed by a stream flowing through the village of Malá Čausa. Studied palaeobotanical material, stored in the Hornitrianske Múzeum in Prievidza, is fossilized in light-gray clays of Eggenburgian age proved by occurrence of molluscs, foraminifers and ostracods. The sediments were laid down in a sea gulf formed during an Eggenburgian transgression. Plant impressions belong to plants that grew near the seashore and on the slopes of adjacent mountains.

Only dicots were chosen from all fossil leaves occurred in the studied collection. They were sorted into morpho-species and were examined for the presence or absence of each of the 31 morphological characters used after CLAMP categorization. A total of 246 fossil samples were studied. Vegetation used in the dataset for this study indicate subtropical climate. The predicted climate parameters for the locality Veľká Čausa are:

- Mean Annual Temperature, MAT – 19,59 °C
- Warm Month Mean Temperature, WMMT – 26,44 °C
- Cold Month Mean Temperature, CMMT – 13,07 °C
- Length of the Growing Season, GROWSEAS – 9,50 months
- Mean Growing Season Precipitation, MGSP) – 215,60 mm
- Mean Monthly Growing Season Precipitation, MMGSP – 24,34 mm
- Precipitation During the Three Wettest Months, 3WET – 98,11 mm
- Precipitation During the Three Driest Months, 3DRY – 46,32 mm
- Specific Humidity, SH – 11,19 g/kg
- Relative Humidity, RH – 76,11 %
- Enthalpy, ENTHAL – 32,21 kJ/kg

Eocene record of soft demosponges from southern Australia: preliminary report.

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Siliceous sponges composed of loose spicules are poorly known from the fossil record because their skeleton usually rapidly dissociates after sponge death. The Eocene sediments of southern Australia contain rich and very diversified siliceous sponge fauna, both bodily preserved and as loose spicules. Three representative sections has been chosen for this study: Hamersley River sections (SW Australia), Norseman section (south-central Australia), and Blanche Point near Adelaide (SE Australia). The sponge fauna is dominated by bodily preserved lithistids but "soft", completely preserved, demosponges also occur, especially in Hamersley River sections. The sediment itself consists in large proportion of very well preserved (opaline silica) loose spicules. The loose spicules belong mostly to demosponges (including lithistids), hexactinellid spicules are rare, suggesting relatively shallow water environment. Based on morphology of spicules, among demosponges dominate representatives of Astrophorida (e.g. families Pachastrellidae, Ancorinidae and Geodiidae), but Poecilosclerida and Hadromerida are also documented. The fauna of demosponges has clear Recent affinities at the family, and to some degree even genus level.

Devonian vertebrate assemblages and elpistostegid-tetrapod diversity in the Baltic palaeozoogeographic province

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The attention to the origin and early evolution of Devonian tetrapods has significantly increased during last years due to new discoveries around and outside the Old Red Sandstone

continent, hence the picture of the sequence of evolutionary events and their timing is much better known, e.g. possible place and time of origin of tetrapods and order of appearance of tetrapod characters within the tetrapodomorph lineage. However, only few papers have been published on the palaeoecology of the tetrapods and their relatives, as well as on the analysis of their place within vertebrate assemblages.

Almost two hundreds years of studies provided a rich and reasonably representative data on the composition of the Middle-Late Devonian vertebrate assemblages from the territory of the so called Main Devonian Field (MDF) (e.g. Esin *et al.*, 2000; Mark-Kurik, 2000). During last decades a new detailed data have been obtained also from other parts of the Baltic palaeogeographic province, including Severnaya Zemlya archipelago (Lukševičs, 1999), Timan and Central Devonian Field (CDF) (Esin *et al.*, 2000), and Belarus (Plax, 2008). Elpistostegids and tetrapods have been found in almost all areas of the Baltic province, including MDF, Belarus, CDF, Middle and South Timan, as well as provisionally Severnaya Zemlya. *Panderichthys* is the oldest member of the group represented in the late Givetian – early Frasnian of the MDF (Esin *et al.*, 2000), early Frasnian of Belarus (Plax, 2008), and possibly in the middle Frasnian of Severnaya Zemlya (Lukševičs, 1999). Other members of these tetrapodomorphs are all local endemics, each recorded from single or closely spaced localities. *Livoniana* comes from the late Givetian of Latvia and Estonia (Ahlberg *et al.*, 2000), *Obruchevichthys* has been reported from the late Frasnian of Latvia and north-western Russia, *Jakubsonia* described from the early Famennian and *Tulerpeton* – from the latest Famennian of CDF (Lebedev, 2004), and *Ventastega* recorded in the latest Famennian of Latvia. Recently two jaw fragments of tetrapod were for the first time recognised by authors among other vertebrate materials from the early Famennian of South Timan during revision of the old collection of F.N. Chernyshev (CNIGR Museum, St. Petersburg).

Analysis of geochronological distribution of vertebrates shows that assemblages from the MDF reach their maximum diversity (29 families of agnathans and fishes) during the Givetian, in contrast to the global diversity reached during Frasnian. The Eifelian assemblages from the studied territory represent 52% of the global diversity of vertebrates, while the middle-late Frasnian and particularly Famennian assemblages contain larger proportion of endemic elements. Index of representativeness of the palaeontological records estimated for the Middle-Late Devonian vertebrate assemblages from the MDF decreases with time, hence creating potential for new discoveries of tetrapods, especially within the Famennian sequence.

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Criboelphidium webbi: An Antarctic foraminifer for detecting climate change in glacier-proximal sediments

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During the survey of Admiralty Bay (King George Island, South Shetlands), in the Australian summer season 2002/2003, 105 species of testate benthic foraminifera were identified. Among them the single taxon from the *Elphidiidae* family stood out. First, it is the only adequately described modern elphidiid known to date from a Southern Hemisphere polar setting (south of latitude 60° S), despite the fact that its relatives are broadly distributed throughout a wide variety of the Arctic habitats. Secondly, it is a species of very strictly defined distribution. It shows clear association with shallow-water settings in proximity of retreating tide-water glaciers, therefore it carries a great potential as paleoclimatic indicator. It appears that it shares similar ecologic affinities like *Criboelphidium excavatum clavatum*, well known from glacier-proximal habitats throughout the Arctic. Even despite many still-open issues concerning its ecology, *C. webbi* appears to be a sensitive glacier-proximal indicator. In Admiralty Bay, the layer bearing its enhanced concentration is clearly related to deglaciation and regional warming. It appears that the *C. webbi*-rich horizons are diachronous, formed within an environmental zone following deglaciation and they may provide a record of past glacier extent and rate of deglaciation. As a matter of fact, a foraminifer closely resembling *C. webbi* was detected in the 77 m sediment core from Firth of Tay, which provided the first complete record of deglaciation and Holocene climate change from the Weddell Sea side of the Antarctic Peninsula. It is significant that this foraminifer is present only at the very base of the sequence between ~9400 and 8300 yr BP, in a paleo-setting much similar to its Recent habitat in Admiralty Bay. This finding strongly confirms that *C. webbi* is a significant paleoenvironmental indicator.

Biostratigraphy and palaeoecology of the Late Campanian – Maastrichtian sediments of the South-Eastern part of the Lublin Upland based on foraminiferal assemblages

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The studied area is located in the South-Eastern part of the Lublin Upland and belongs to two geomorphologic units: Hrubieszowska Valley and Grzęda Sokalska, comprising Mircze, Dołhobyczów and Dłużniów sheets. The Cretaceous sediments are developed as the cream-grey, light grey marls. The studied samples have been collected from the borehole material and contain abundant and generally well preserved microfauna.

The foraminiferal assemblages are dominated by calcareous benthic species: *Bolivinodes draco draco*, *Coryphostoma plaita*, *Gavelinella danica*, *Praebulimina arcadelphiana*, *Bolivinoidea decorata gigantea*, *B. decoratus*, *Gavelinella pertusa*, *Guttulina trigonula*, *Gyroldinoidea girardana*, *G. globosus*, *N. reticulata*, *Quadriformina minuta*, *Pulenia cretacea*, *P. jarvisi*, *Praebulimina carsayae*, *P. reussi*, *Pseudowigenerina cristata*, *Stenstoeina pommerana*. Among the planktonic associations non-keeled foraminifers such as: *Hedbergella holmdelensis*, *H. monmouthensis*, *Heterohelix globulosa*, *H. navarroensis*, *H. striata*, *Racemiguembelina fructicosa*, *Globigerinelloides multispinus*, *G. prairielillensis*, *Guembelitra cretacea*, *Archaeoglobigerina blowi*, *A. cretacea* and not so numerous *Rugoglobigerina hexacamerata*, *R. milamensis*, *R. rugosa*, *Globotruncanella petaloidea*, *G. havanensis* dominate. Planktonic keeled forms are relatively rare, represented by *Globotruncana aegyptiaca*, *G. arca*, *G. bulloides*, *G. linneiana*, *Globotruncanella stuartiformis*, *Globotruncanella havanensis*. Scarce agglutinated taxa: *Arenobulimina* sp., *Caudammia gigantea*, *C. ovulum*, *Gaudryina laevigata*, *G. rugosa*, *Heterostomella leopolitana*, *Orbignyina inflata*, *O. variabilis*, *Tritaxia* sp. are also identified.

The age of the sediments has been estimated as Late Campanian – Maastrichtian and the local foraminiferal biozones were established. The studied sediments were deposited in the depth corresponding to the middle - external shelf, to the upper part of the continental slope environments. The presence of the Tethyan planktonic foraminiferal assemblages as well as the Boreal ones indicates that the studied associations belong to the transitional province located between the Tethyan and the Boreal domains zones and supports the existence of “gateway” between both biogeoprovinces located nearby the studied part of the basin.

Upper Carboniferous silicified calamite stems from the Krkonoše Piedmont Basin – preliminary report

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Calamite stems seem to be strictly related to only one stratigraphic unit in the Upper Carboniferous sediments of the Krkonoše Piedmont Basin. This unit is the so-called “Ploužnice Horizon” (Semily formation, Gzhelian - Stephanian C), composed of mudstones and siltstones as well as volcanic sediments and lacustrine limestones. As already stated by Sakala et al. (2009), all studied stems most likely belong to the form genus *Arthropitys* Goeppert. The only record of *Calamitea* Cotta from the vicinity of Nová Paka (Rößler and Noll 2007: 169) corresponds to a historical specimen from Libštát, which is housed in the Museum für Naturkunde in Chemnitz. The distinction whether the fossils belong to *Arthropitys ezonata* Goeppert emend. Rößler and Noll (Rößler and Noll 2006), *A. bistrata* (Cotta) Goeppert emend. Rößler and Noll or newly defined *A. sterzelii* Rößler and Noll (Rößler and Noll in press) is the aim of the current research. Finally, it seems that an important part of specimens traditionally considered as calamites, are in fact small cordate stems or even woody central parts of arborescent lycopsids (R. Rößler pers. comm.).

Geochemical analyses confirmed highly crystalline quartz (SiO₂) and more than a single-phase kind of the very specific permineralization process. Very good preservation of wood was also proved by hot cathodoluminescence (CL), either individual cell wall layers are sometimes visible. Striking CL patterns of preserved calamite anatomy and conspicuous overprints of silicification might represent a possible influence of volcanism or postvolcanic activities that contributed to the final taphonomy of these silicified stems (Sakala et al. 2009). Based on these data the palaeoenvironmental and climatic conditions during the plant growth can be considered as rather humid and swampy.

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Early Triassic biotopes in the Hronic Superunit of the Western Carpathians

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During Scythian time, the Hronicum area represented a transitional zone between terrestrial plains with occasional fluvialite sedimentation (the Lúžna Formation in the Tatric and Fatric units) and permanently inundated marine shelf (Szín Formation in the Silicic Domain) of the Meliata Ocean. This is the reason why the Šuňava Formation comprises beds with brackish and marine faunal remnants.

Lower Triassic arcoses of the Šuňava Formation bears several indicators of shallow neritic environment, namely heterolithic bedding, ripplemarks, bioturbated beds and vertical ichnofossils of the Skolithos ichnofacies. Finding of shells accumulation of linguloid brachiopods and of poorly preserved bivalves (*Myophoria* and *Anodontophora*) on the Šalková locality near Banská Bystrica was even more interesting. Similar findings come also from localities of Amon, Bučková, Čelo and Kubašová in the Malé Karpaty Mts.

Trace fossils occur in three levels described in several Lower Triassic successions of the Choč Nappe. The first ichnofossil association contains sporadically occurring *Diplocraterion*, *Arenicolites* and *Skolithos*. Cylindrical horizontal *Planolites* traces occur higher up in the sequence. Finally, even higher, densely bioturbated layers with vertical traces can be found. Co-occurrence of several shaft traces with lingulid brachiopods that lived on surface of delta

cones evokes their probable origin. However, trace makers of many other trace fossils remain unknown, yet.

Preorogenic position of the Magura Basin

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The Magura Basin developed during the Late Jurassic-Early Cretaceous period as the eastern prolongation of the Valais domain. In the pre-orogenic evolution of the Magura Basin the several prominent periods can be distinguished: Middle Jurassic-Early Cretaceous syn-rift opening of basins, followed by Late Cretaceous post-rift thermal subsidence, latest Cretaceous-Paleocene syn-collisional inversion, Late Paleocene to Middle Eocene flexural subsidence and Late Eocene - Early Miocene closing of the basin. The driving forces of tectonic subsidence of the basin were syn-rift and thermal post-rift processes, as well as tectonic loads related to the emplacement of accretionary wedge. This process was initiated at the end of the Paleocene at the Pieniny Klippen Belt/Magura Basin boundary and was completed in Late Oligocene in the northern part of the Magura Basin. During Early Miocene the Magura Basin was finally folded, thrust and uplifted as the Magura Nappe.

The youngest folded turbidites deposits of the Magura Nappe belong to Early Miocene NN1-2 calcareous nannoplankton zone (Oszczytko et al., 2005, Oszczytko & Oszczytko-Clowes, in print). These deposits belong to the uppermost part of the Poprad Sandstone Member (Magura Formation) and to Kremna/Zwada Formation. These formations were supplied from the "unknown" exotic source located somewhere at SE termination of the Magura Basin. Recently, two papers occurred (Ustaszewski et al., 2008 and Marton et al., 2009), which made possible partly to solve the provenance of clastic material during the terminal stage of the Magura basin evolution. This Early Miocene reconstruction of preorogenic position of the Magura Basin takes into account paleomagnetic data, estimates of shortening and extension as well as the position and organization of main structural domain of the Western and Eastern Inner Carpathians.

According to Marton et al. (2009) the post-folding paleomagnetic remanences of the Magura and Silesian nappes show a general 50°counterclockwise (CCW) rotation. This also suggests that the Magura Basin was open towards the East during the terminal stage of the development.

Ustaszewski et al. (2008) model shows the Early Burdigalian (20 Ma) position of main terranes and basins before the onset of Miocene to recent deformations. The main assumption of these reconstruction is 23°counterclockwise (CCW) rotation of ALCAPA Mega-Unit, 38° clockwise (CW) rotation of Tisza Mega-Unit, and 16,5° clockwise (CW) for Dacia Mega-Unit. In such case the length of the Magura basin was at least 400 km and up to 150 km wide at the east termination of this basin. In the South, Pieniny Klippen Belt and Magura Basin contacted the ALCAPA-Mega Unit along trace of subduction zone. At the same time the Tisza and Dacia Mega-Units composed the Eastern termination of the Magura Basin. Such configuration of the basin boundaries indicates the possible position of the source areas. Now it is possible to accept that Magura Basin was supplied both from the East (Tisza and Dacia Mega-Units -longitudinal transport) and from the South (accretionary wedge in front of overthrusting ALCAPA-transversal transport).

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Hunting strategies of Gravettian hunters based on paleoecology of large gregarious animals

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Large settlement units based in strategic locations, from which the control over valleys and/or rivers is possible, are characteristic for Upper Paleolithic Gravettian culture in the Danube region (the Gravettian landscape of type "C" Svoboda et al. 2002; Škrdla 2005). Settlements are located in altitudes between 200 and 300 m a.s.l., or in the vicinity of thermal springs, which did not freeze even throughout winters and dangled wild animals (such as Předmostí or Dolní Věstonice). There were also higher accumulations of loess deposits in the same locations, which enabled conservation of the remains left by Upper Paleolithic hunters. The number of sites in that time decrease, but is connected with increase of their area and the number of artefacts found there (Svoboda et al. 2002).

The results of dental enamel increments of the teeth roots of hunted animals testified perennial occupancy of the sites (base camps) such as Dolní Věstonice-Pavlov settlement cluster, Přerov-Předmostí, Krems or Moravany-Lopata II (Nývtová Fišáková 2007, 2008, 2009). Located geographically between these perennial sites are numerous seasonal settlement units (seasonal camps), which connected base camps. They are located along the migration paths of animals and also along the human migration paths used for the transport of raw material for artefacts production (Škrdla 2005). Two different hunting animal groups and seasons of their hunting may be as certain using dental enamel increments of the teeth roots. The first group involves animals, which migrated during spring and autumn for feed (such as mammoths and horses) or were hunted for their fur (foxes, wolverines and hares). These animals were hunted mostly during spring and autumn. The second group comprises non-migrating animal species and they may represent the first domesticated animals (reindeers and wolves). Those animals were killed throughout the whole year (Nývtová Fišáková 2007, 2008, 2009).

The isotopic ratios of strontium, stable isotope contents of oxygen, carbon and nitrogen were employed to reveal migrations, diet and implied environmental conditions. Based on ⁸⁶Sr/⁸⁷Sr ratio, mammoths and horses were migrating animals. Mammoths migrated along the main Danube valley, through the Moravian Gate up to the southern Poland and along the

Danube against the Váh valley. Reindeer of the Evolved Gravettian times did not migrate and they very probably represented so-called forest reindeer forms. However, in the Late Gravettian (so-called Willendorf-Kostenki phase) climate deteriorated (the OIS 3 and OIS 2 boundary) and reindeers started to migrate.

The park steppe prevailed during the Evolved Gravettian (32–30 ka cal. BP) in the middle Danube region according to the oxygen and nitrogen isotope ratios. But it changed to tundra in the Late Gravettian times (28–24 ka cal. BP) close to the OIS 3 and 2 boundary (Nývltová Fišáková 2007, 2008, 2009).

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Paleoecological Interpretation of the Rapovce GTL – 2 drilling (Lučenská kotlina depression)

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Rapovce GTL-2 drilling is situated in the Lučenská kotlina Depression at the village Rapovce in the Southern Slovakia. It was studied for biostratigraphical and paleoecological purposes on the basis of calcareous nannofossils and foraminifers. The age of sediments was defined from Oligocene (Upper Rupel) to lower Miocene (Upper Eger/ Eggenburg), nannoplankton zone NP 23 – NN2 (sensu Martini 1971) and foraminifers zone P19 – P21.

The studied assemblage of the calcareous nannofossils was quantitatively and qualitatively rich. The nannoplankton zone NP23 – Sphenolithus predistentus was composed mainly from species *Dicryococites bisectus*, *Coccolithus pelagicus*, *Zygrhablithus bijugatus*, *Cyclicargolithus floridanus*, *Helicosphaera compacta*, *Helicosphaera bramlettei*, *Helicosphaera recta*.

The nannoplankton zones NP 24/25 (595 – 315 m) were determined on the basis of first occurrence of the species *Cyclicargolithus abisectus*. The stratigraphically important species *Helicosphaera recta*, *Helicosphaera euphratis*, *Helicosphaera perch-nielseniae*, *Helicosphaera truncata*, *Reticulofenestra lockeri*, *Reticulofenestra hullae*, *Pontosphaera latelliptica* were found. The most common species were *Dicryococites bisectus*, *Cyclicargolithus floridanus*, *Coccolithus pelagicus*, *Coccolithus eopelagicus*, *Cyclicargolithus abisectus* and *Zygrhablithus bijugatus*.

The border of the zones NP24/NP25 was impossible to determine due to very rare occurrence of species *Sphenolithus distentus*.

The nannoplankton zone NN1 Triquetrorhabdus carinatus was determined in the interval 315 – 170 m on the basis of the first occurrence of species *Sphenolithus conicus*. The composition of the nanoassemblage is similar as in the previous zones. Species *Dicryococites bisectus*, *Cyclicargolithus floridanus*, *Coccolithus pelagicus*, *Cyclicargolithus abisectus* dominated. The stratigraphically important species were *Helicosphaera recta*, *Helicosphaera euphratis*, *Helicosphaera truncata*, *Reticulofenestra lockeri*, *Pontosphaera latelliptica*.

Zone NN2 Discoaster druggii (170 – 160 m) were determined on the basis of first occurrence of the species *Discoaster druggii* (Halásová in Vass et al., 2008), which is the index species for the Oligocen/Miocene border and nannoplankton zones NN1/NN2. Miocene species *Holodiscolithus macroporus*, *Triquetrorhabdus cf. carinatus*, *Helicosphaera mediterranea*, *H. cf. scissura* were found.

Upper Eocene and Mesozoic species like *Reticulofenestra umbilicus*, *Istmolithus recurvus*, *Lanternithus minutus*, *Arkhangelskiella cymbiformis* were found rare in all samples.

The paleoecological events were observed in the interval 490 – 495 m, when the subjects were small and contained Diatomaceae in the assemblage – this indicated a terrestrial stream.

Growth of the species *Pontosphaera latelliptica*, *P. discopora*, *P. rothi* was located in the interval 390 – 380 m, this species occurred in nearshore conditions.

The nanoassemblage was quantitatively rich in the interval 340 – 315 m, this can signalize stream of the nutrient.

Upper Rupel foraminifers species from the lower part of the borehole – Číž formation – belonging to the zones P19 – P22 (Soták in Vass et al., 2008) determined in this Borehole were composed of planktonic foraminifers, eg. *Paragloborotalia nana*, *P. opima*, *Globorotalis ampliaperta*, *Globogerina venezuelana*. Very important species is *Paraglobalia opima*, because its last occurrence is in the boundary between planktonic zones P21 and P22. The planktonic taxa are accompanied by the benthic foraminifers, eg. *Lenticulina arquatostriata*, *Lagena sulcata*, *Sphaeroidina variabilis*, *Heterolepa dutemplei*, *Chilostomella tenuis*, *Cassigerinella chipolensis*, *Tenuitella brevispira*, *Stilostomella adolphina*, *Lenticulina budensis*, *Semivalvulina pectinata*.

From the Lower Egerian foraminiferal assemblage species like *Globigerinoides primordius*, *Tenuitella angustumbilicata*, *Catapsydrax martini*, *Globoturbotalia cf. woodi*, epibenthic forms as *Pellenia bulloides*, *Cibicides ungerianus*, *Gyrogoninoides soldani*, *Sphaeroidina cipeana*, *Lenticulina cultrata* and others were determined. From rich agglutinated foraminifers occurs *Trochammina globigeriniformis*, *Trochammina inflata*, *Haplophragmoides sp.* and others.

First evidence of the Early Eocene Climatic Optimum (EECO) in the Central Western Carpathians: foraminiferal and nannofossil indices

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The high-resolution analysis of the nannofossils and foraminifers in the Kršteňany section provides a proxy record of the Early Eocene Climatic Optimum. The studied assemblages of the calcareous nannofossils are quantitatively and qualitatively rich. Nannoplankton zones NP

12 – NP 16 (sensu Martini 1971), characteristic for Middle and Upper Eocene deposits were determined as follows:

In the lowermost part of the section the Nannoplankton Zone NP 12 – *Tribrachiatius orthostylus* has been recognized, based on the presence of the species *Ellipsolithus macellus* and *Tribrachiatius orthostylus*. These species have their last occurrence on the top of this zone.

The Zone NP 13 – *Discoaster lodoensis* was recognized in the interval between samples VK 013 and VK 08 based on the absence of *Tribrachiatius orthostylus*. This species has its last occurrence on the top of zone NP 12.

The Zone NP 14 – *Discoaster subloedenis* was recognized according to the appearance of *Lanternithus minutus*, which have his first occurrence on the base of Zone NP 14. In this zone radiated bloom of the family *Discoasteraceae* – with more than 10% partition in the assemblage, indicated EECO (Early Eocene Climatic Optimum, Agnini et al. 2006). The most common species were *Discoaster barbadiensis* and *D. saipanensis*.

The top of *Discoasteraceae* – bloom was recognized in the samples VK 08 – VK 05. In the next samples their number decreased.

The Zone NP 15 – *Chiphragmalithus alatus* was recognized as a very poor nannofossil assemblage in the interval between samples VK 4 – VK10. In this zone, discoasters were very rare, replaced by placoliths, such as *Dictyococites bisectus*, *Coccolithus pelagicus*, *Cyclicargolithus floridanus*, *Reticulofenestra* sp.

The Zone NP 16 – *Discoaster tani* nodifer was assigned on the basis of the presence of *Helicosphaera compacta*, which is characteristic of upper part of the Zone NP 16. This zone was designated for the interval VK 11 – VK 15.

Foraminifers have also been studied with similar results. Ypresian biozone P 9 with species *Subbotina (T) boweri* have been recognized in lower part of the section (interval between (VK 015 – VK 02). The interval VK 02 – VK 8 was assigned as Lower - Middle Lutetian with foraminiferal zones P10 – P11, with characteristic species *Acarinina cuneicamerata*, *A. bullbrooki*, *A. interposita*, *A. matthewsae*. Upper Lutetian foraminiferal biozones P11 – P12 with significant species *Morozovella aragonensis*, *M. crater*, *M. spinulosa* and Upper Lutetian – Bartonian and foraminiferal biozones P 13 – P14, with species *Acarinina (T.) topiletsis* and *Morozovelloides crassata* have been established.

Based on the nannofossil study in the Vefké Kršteňany section we can reconstruct the paleoenvironment. The nannofossil associations characterize the period before EECO (interval between samples VK 015 - VK 08), EECO – period, characterized by the *Discoasteraceae* - bloom (interval between samples VK 08 – VK 4) and cooling term (from samples VK 5).

Extrinsic factors and morphometrical variability of *Cyprideis* (Ostracoda) in the non-marine basins

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Cyprideis is common genus in the non-marine continental basins since its appearance in the Oligocene/Early Miocene and it occurs in numerous endemic and morphologically highly variable populations.

The female right valves in external lateral view were digitalized using the published images from the Amazonian Basin, Lake Tanganyika, Turkish and European Neogene basins, South and North Americas and the optic images of the *Cyprideis* species from the Late Miocene Lake Pannon. Special attention is paid to *Cyprideis torosa* from different stratigraphical and geographical sites. For the reconstruction of valve outlines, the B-splines approach adapted to ostracods and known as Linhart's algorithm is used. Non-metric Multidimensional Scaling (N-MDS), ANOSIM for 1-way layout, and PCA is used to attest the morphometrical traits and variability of the species in the basins.

Cyprideis of the Late Miocene Lake Pannon show higher than variability of *Cyprideis torosa* and European Miocene species, but still low in comparison to *Cyprideis* of other large basins. Detailed examination of the hinge of the Lake Pannon species shows the changes in degree of dentition, thickening of the hinge elements and division of anteromedian tooth which accumulated in a time, but ecological and tectonical evolution of that basin blocked an advanced morphological separation of the species. A morphometrical variability increases in the Americas and Turkish Neogene, mainly Late Miocene *Cyprideis*. Morphometrical variability within these groups can be explained by ecological and geographical barriers which separated the populations. The Middle and Late Miocene Amazonian and extant Tanganyikan species show the highest variability and advance morphological traits induced probably by long evolutionary time, and in a case of Tanganyikan species, the *Cyprideis* and their descendants obtained the characters homeomorphic with Paratethyan Hemicytherinae.

The Middle-Late Miocene and Quaternary/Recent *Cyprideis* have the largest morphometrical variability linked with an existence of the large long lived basins. Within these basins, the freshwater lakes in tropical climate offered the best conditions for an evolution of this brackish genus.

Siliceous sponges form the Dalichai Formation (Middle Jurassic), Alborz Mts, NW Iran

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Middle Jurassic siliceous sponges, in contrast to Late Jurassic sponges, are rather poorly known and inadequately described. A siliceous sponge rich facies of the Middle Jurassic has been recently discovered in NW Iran, near the town of Maragheh (northeast Alborz). The sponges come from the Dalichai Formation at Kuh-e-Goudagh, southeast of Maragheh. At the studied section the Dalichai Formation consists of an alternation of bluish-grey marls and limestone and contains besides ammonites a rather rich sponge fauna. The ammonites indicate a Late Bajocian to Early Bathonian age of the sponge bearing strata. The sponge fauna is dominated by hexactinellids, while lithistid sponges are represented in the collection only by two species belonging to two different taxa of rhizomorines (probably *Platychonia* and *Hyalotragos*). Among hexactinellids, hexactinosan sponges dominate. These belong to typical late Jurassic genera *Sphenaulax*, *Stauroderma* and *Tremadictyon*. The diversity of hexactinosan sponges is higher, as exhibited by their morphology, but many specimens are difficult to

determine because of poor preservation of skeleton. Representatives of lynchisocosan sponges are less common but they are also represented by several genera, i.e. *Pachyteichisma*, *Cypelia* and *Trochobolus*, all known also from the Late Jurassic rocks. This is the most diversified lynchisocosan assemblage so far known from the Bajocian-Bathonian rocks, where only two species have been reported, suggesting a much longer history of the lynchisocosan clade.

The Late Messinian and Pliocene limnic Ostracoda of Albania

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Rich brackish and freshwater ostracod assemblages have been found on two sections of the External and Internal Albanides sampled by authors in the scope of IGCP Project 329. DUMRE (KOSOVA) SECTION

The section is a part of the external Albanides in which a total thickness of the Messinian deposits according to micropaleontological data of the Kosova-2 drilling reach about of 1100m. Sandstone, siltstone and clay alternate in the lower part of the section, which in many cases contain only reworked foraminifers and rarely valves of *Cyprideis* sp. Absence of marine fauna *in situ*, scarce presence of *Cyprideis* and their uppermost Messinian age suggest to include this part of the section in "Iago-mare" biofacies (Prillo and Hasanaj, 2002). These deposits go up irregularly through the conglomerate bed marking the lithological unconformity at the beginning of Pliocene, and these passing upward to clayey deposits. Their Early Pliocene age is based on the autochthonous benthic foraminifera *Marginulina cherenis* Tedeschi and Zanmatti, *M. coarctata* Silvestri, *Bolivina placentina* Zanmatti, *Ammonia pinuseptata* Miatluk. This foraminiferal assemblage in clayey horizons and the rare planktonic foraminifera indicate a neritic environment with rapid transition into coastal deposits represented here by massive conglomerates of the Pliocene regressive phase - Rogozhina Fm with a total thickness of over 50m.

A rapid change in lithology and paleoenvironment is observed above the conglomerate which is covered by the marly limestone barren of fossils. A less carbonate deposits contain a rich ostracod assemblage composed of brackish *Cyprideis* ex. gr. *torosa* (*C. torosa* forma *torosa tuberculata* and forma *lithoralis*), and juvenile valves of freshwater *Candona* sp. and *Iloocypris* sp., while *Candona* (*Negleacandona*) *paionica* Petkovski, *C. (Negleacandona)* sp., *Paracyprinotus* sp. occur rarely. In this assemblage several Characean gyrogonits were found indicating water depth only till 6-7m, by account of wave transport, maybe down to 10m. KASTRIOT (PESHKOPI) SECTION

A small section inside of the Internal Albanides is important due its similarity to the upper part of Central Greece and Southern Serbia. Clay with thin silty intercalation, exposed about 5 km to the northwest of the Peshkepi town, contains molluscs *Valvata graeca* Fuchs, *Ohridopyrgula gladilini* Pavlović, *O.* sp. and ostracod assemblage characteristic for the late Pliocene age. Three ostracod taxa - *Candona* (*Zalanyiella*) cf. *depressa* (Klie), *Candona* ('*Caspiocypris*') cf. *holmesi* (Petkovski), *Paralimnocythere* aff. *georgevitschi* (Petkovski) - have an affinity to extant species of the Lake Ohrid and Prespa and are identical to taxa of Metohia and Lokride (Georgiades-Diokeoulia et al., 2002).

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Terrace lines and ridges as an autecological factor of Genus *Bollandia* Reed, 1943 (Trilobita)

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The discovery of new trilobites within the Březina Formation in the Mokrá quarry should substantially implement our current knowledge of Moravian Carboniferous trilobites. In this work, the occurrence of bollandines in Moravia is documented for the first time which demonstrates the obvious palaeogeographical affinities of Czech trilobite assemblages to other European Carboniferous faunas, especially that of the Harz Mountains (Hahn et al. 1998, 2003). However, further investigations are needed to precisely determine to which facies-constrained associations recognized in Belgium and Germany (Hahn 1990) the new Moravian fauna corresponds to.

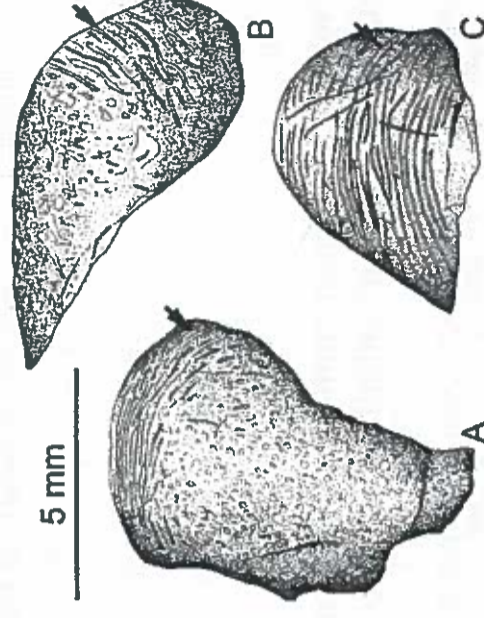


Fig. 1 *Bollandia persephone*

The associated adaptive radiation is clearly illustrated by the emergence of morphological characteristics like that of *Bollandia* which have no equivalence in Famennian trilobites. We interpret these morphological particularities in *Bollandia* as indicative of an epibenthic lifestyle, with possible abilities for digging, and of predatory/scavenging feeding habits. Of course, trilobites have displayed a far greater ecological diversity in the Early Carboniferous, but a correct assessment of this latter still awaits for a quantitative analysis of trilobite disparity at that time to be performed.

Remarks on the autecology of *Bollandia*

The exoskeleton of *Bollandia* exhibits some morphological traits which are potentially informative with regard to the autecology of this trilobite. The glabella, for example, greatly expands forwards to overhang the anterior border, frequently exceeding it forwards. A bulged glabella of that kind suggests the hypostome was likely 'secondarily attached' in this taxon following an impendent style (Fortey, 1990: p. 538, 543), a character which has been associated to scavenging/predatory habits in trilobites (Fortey & Owens, 1999: 434). However, the development of structures resembling terrace ridges on the anterior part of the glabella in *B. persephone* (Fig. 1) might indicate some abilities for digging in this species (Schmalfuss, 1981). In this regard, *B. persephone* recalls some scutelluids with vaulted exoskeleton, like the (?Silurian-) Early Devonian *Paralejurus* (e.g. *P. rehamanus*, Schraut & Feist, 2004, fig. 7) or the Frasnian *Telopeltis* (especially *T. woodwardi*, McNamara & Feist, 2006, figs. 3.1-6), which have been regarded as semi-endobenthic forms (Schraut & Feist, 2004). *Bollandia* generally exhibits a wide axis and rather vaulted exoskeleton which might confirm some digging abilities.

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Paleoecology of some Valanginian ammonoids: evidence from their abundance variations and isotopic data of the shells

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Interpretations of mode of life and habitat of some mid-Valanginian ammonoids until recent times are mainly based on their shell functional morphology. Two different approaches have been used in our study: quantifying the absolute abundance of ammonoids and measuring isotopic compositions of well-preserved aragonite shells.

The study of absolute abundance variations is based on 9688 ammonoids and 557 bivalves derived from a marl-limestone alternation of the Vergol section (Montbrun-les-Bains, Drôme, Vocontian Basin, SE France). Macrofauna was quantified in 42 sampling stations. Quantity of macrofauna was standardised to 1 m³ of sediments. Mid-Valanginian ammonoid assemblages are characterized by two morphologic types: orthocones, represented by *Bochianitidae*, and involute/evolute planispirals from other families. *Bochianites* are dominant in several intervals where they can represent 50 to 90% of the ammonoid assemblages. The absolute abundance of *Bochianites* is poorly or negatively correlated with those of planispiral ammonoids ($-0.153 < r < 0.412$; $n = 42$). Furthermore the absolute abundance of the orthocones is strongly varied. Similar abundance variations are observed for bivalves as well. Their abundance is relatively well correlated with that of *Bochianites* ($r = 0.815$; $n = 42$) and low or negatively correlated with the abundances of planispiral ammonoids ($-0.168 < r < 0.301$; $n = 42$). Taphonomy of specimens suggests rapid shells sinking and burial; therefore, most of the variations in ammonoid absolute abundance are not resulted from post-mortem shell transport. Dilution cycles by platform-derived carbonate mud or by clay input might have partly controlled the variations in macrofauna abundance but cannot explain different trends observed between benthic and nektonic macrofaunas and between different ammonoid taxa (Reboulet *et al.*, 2003). These significant variations of macrofaunal abundance are better interpreted in terms of response to paleoenvironmental changes and different paleoecologies of the taxa analyzed.

The second part of our study is based on the stable isotopes $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ composition of mid-Valanginian original aragonite ammonoid shells from Wałat section in Central Poland (Polish Basin). The shells were studied by X-ray diffraction method which indicates pure aragonite composition. The results of analysis of Sr, Mg, Na, Mn, Fe contents of aragonite are in agreement with those of recent nautiloids. Scanning electron micrographs of surfaces of ammonoid shells show ultrastructures without recrystallization and diagenetic changes. In the sediment there is no record of excessive evaporation, glacial ice or strong influx of river water which could change isotopic composition of water. This record reflects the original depositional seawater conditions (Ploch 2007). To estimate surface and bottom seawater temperatures, oxygen isotope ratios were also studied on benthic organisms (bivalves' shells and echinoid spines). Two main groups of ammonoids can be individualized with respect to isotopic data. The record of $\delta^{18}\text{O}$ composition for *Bochianites*, *Dichotomites* and *Prodichotomites* is in a set of values from 1.5 to -0.5 ‰ which indicates rather lower water paleotemperature. Their shell morphology suggests nektobenthic mode of life. Paleotemperatures estimated for this group are similar to those of bivalve shells and echinoid spines. The second group (Olcostephanidae: *Saynoceras*, *Valanginites*, *Olcostephanus*) is characterized by negative $\delta^{18}\text{O}$ values; this could indicate higher temperatures, probably records of surface waters.

In conclusion, all these observations provided by the quantification of the macrofauna abundances and the geochemical analysis of shells shown that *Bochianites* had deep-nektonic, possibly nektobenthic mode of life (Reboulet *et al.*, 2003; Ploch, 2007).

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Cave lion from the Western Tatras Mts.: taxonomy, age and palaeoenvironment

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The Late Pleistocene cave lion (*Panthera spelaea*), descendant of European steppe lion from Early to Middle Pleistocene (*Panthera fossilis*), represents a specialized form of large felid close relative to modern lion (*Panthera leo*). Its fossil record within the territory of Slovakia was so far restricted to the areas of Malé Karpaty Mts. (Tmavá skala Cave, Deravá skala Cave), Považie (Čertova pec Cave, Prepošiská Cave, Pružinská Cave), Nízke Tatry Mts. (Okno Cave, Vyvieranie Cave), Slovenský raj Mts. (Medvedia Cave) and Slovenský kras (Domica Cave).

A nearly complete skeleton of cave lion from the Medvedia Cave in the Západné Tatry Mts. (Western Tatras Mts.) is the latest find, representing the best preserved (more than 70% of the skeleton is preserved, including skull, backbone and bones of fore- and hind limbs) and the highest situated (the site altitude is 1,133m) record of this large predator in Slovakia. The fossil remains belong to a young adult male whose measurements indicate one of the largest specimens of the species in Europe.

Based on the AMS dating of cave bear fossils (in VERA-Laboratory, Vienna), which have been found within the same layer of excavated part of the cave part together with cave lion skeleton, the age of find (> 46 ka BP) corresponds with a period before the Moershoofd Interstadial (46 – 44 ka BP) within the European stratigraphical scale of the Late Pleistocene. It is also supported by $\delta^{18}\text{O}$ analyses from bear teeth under study, providing an evidence for a mild/warm climatic oscillation during some of OIS 3 interstadials. $\delta^{13}\text{C}$ palaeodiet data from analysed bear bones and teeth, however, show large scattering range, indicating cooler and warmer time intervals within the middle part of Last Glacial. Based on that, a steppe to meadow character of the site vicinity is assumed for cooler intervals, whereas the presence of open forest in the surroundings of the cave is assumed for warmer ones.

Albian to Cenomanian dinoflagellate cysts from the Fore-Magura Unit

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The Fore-Magura Unit occurs in tectonic slices along the front of the Magura Group of Nappes in northern Moravia and western Poland (Eliáš et al., 1990). Strong tectonic disturbance makes difficulties with establishing a lithostratigraphy of the unit. The known stratigraphic sequence of the Fore-Magura unit extends from the Campanian to the Oligocene. The deposits of the Fore-Magura unit show many similarities with the coeval strata of the Subilesian and Silesian units.

The Upper Cretaceous strata of the Fore-Magura Unit comprise mostly variegated shale red brown, gray, and gray green in colour, with varying carbonate content and silt admixture. These strata are enclosed within the Submenilite Formation. The Upper Cretaceous of the Fore-Magura Unit contain mixed taphocoenose of foraminifers dominated by deep-sea agglutinated taxa locally accompanied by the "Marssonella fauna" (Bubík et al., 2008). Calcareous benthic and planktonic taxa are less common. Agglutinated taxa *Uvigerinamina jankoi*, *Bulbobaculites problematicus*, *Tritaxia subparisiensis* as well as planktonic taxa *Dicarinella concavata* and *Marginotruncana sinuosa* from several localities evidence age within the Santonian-Campanian interval. Poor nannofossils with *Lithastrinus grillii* and *Prediscosphaera* sp. cf. *P. grandis* (sensu Burnett 1998) allow assignment to the zone UC11c, base of the Santonian. et. The shales of the Submenilite Formation were deposited in bathyal below the lysocline of calcite based on the lithology as well as taphocoenoses of microfossils.

The oldest strata of the Fore-Magura Unit are probably dark-grey noncalcareous shales with green-grey claystones which are discovered in the Javořínský potok near Bělá (Bubík et al., 2008).

The pelitic sediments are palynologically very rich. The composition of palynomorphs is characterised by a rather high content of sporomorphs (pollen and spores, 50% as maximum). The majority of paleoecologically significant dinoflagellate cysts from the black shales present (*Circulodinium* and *Odontochitina*) belong to littoral and brackish groups. Neritic dinocysts *Achomosphaera* and *Spiniferites* are also present. The presence of deep water (oceanic; *Pterodinium*) dinocysts reflects an open marine palaeoenvironment. This palynofacies characterize open marine conditions with redeposition of nearshore dinocysts with eutrophic and less saline surface waters.

The assemblages of dinoflagellates are composed mainly of deep-sea representatives as *Achomosphaera ramulifera*, *A. triangulata*, *Hystriodinium pulchrum*, *Kleithriasphaeridium eoinodes*, *Oligosphaeridium complex*, *Pervosphaeridium pseudhystrichodinium*, *Spiniferites ramosus*, *Surculosphaeridium longifurcatum* a *Xiphophoridium alatum*. The assemblage with *Epelidosphaeridia spinosa*, *Palaeohystrichophora infusorioides*, *Pervosphaeridium pseudhystrichodinium* and *Xiphophoridium alatum* is typical for uppermost Albian to Middle Cenomanian. The dinoflagellate cysts assemblage is similar to assemblages from uppermost part of the Lhoty Formation of the Silesian unit.

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Radiolarian microfauna from the Coniacian – Campanian formations of the Manín Unit: implications for biostratigraphy and paleoenvironments

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The investigated section is formed by red-bed sediments, which cropping out in the forest road behind a cemenetry near Praznov village (Middle Váh Valley).

Occurrences described here represent by now the first findings of this radiolarians microfauna in the Santonian-Campanian formation from the Slovak territory.

Radiolarians assemblage from the middle part of studied profile corresponds to stratigraphic interval from the Coniacian? to the Upper Santonian.

Association from higher parts is characteristic for the stratigraphic interval from the Santonian to the upper Campanian. According to zonation Hollis & Kimura (2001) both associations belong to zone *Dictyomitra kozlovae*.

The samples were relatively rich in representatives of the family *Pseudoaulophacidae*. According to Višňevska & Basov (2007) they finish their occurrence at the boundary of the Santonian/Campanian. Therefore, assemblages under the boundary of the Santonian/Campanian are apparently present in our samples, representing only lower part of the zone *Dictyomitra kozlovae* (Dk1), which corresponds to the Santonian.

From the obtained proportion of S/N we can assume that attendant assemblage show likely deterioration of environmental conditions responding to previous significant biotic event during Santonian – Campanian.

On the basis of foraminiferal associations, stratigraphic interval was determined from the Cenomanian to the upper Campanian. The Middle Turonian part is represented by the species *Praeglobotruncana oraviensis trigona* (Scheibnerová). The interval with the species *Falsomarginotruncana renzi* (Gandolfi), *Marginotruncana terfayaensis* (Lehman), *Marginotruncana pseudolinneiana* Pessagno, *Marginotruncana coronata* (Bolli) and *Contusotruncana cornicata* Salaj represents stratigraphic interval from the Coniacian to the Santonian. The youngest part of the section represents the Upper Campanian with the index taxon *Globotruncana arca* (Cushman) and *Globotruncana ventricosa* (White).

High-resolution microbiostratigraphy across the Cenomanian-Turonian boundary (Western Carpathians): a proxy data for Oceanic Anoxic Event 2

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The Mid- to Late Cretaceous changes in global oceanic regime led to reddish colored deep-water pelagic deposition in the Carpathian basins (Puchov Marls *sensu* Stur 1860). Red

bed formations appeared here as early as during Albian (*Rotalipora ticinensis* Zone) and continued during the Cenomanian and Turonian. The red beds recorded short-timed fluctuations in content of foraminifers and radiolarians, considering their morphotypes, feeding mode, life-strategies, productivity changes, water-column depth, etc. Generally, the foraminifers living in the thermocline (deep sea dwellers) and adapted to oligotrophic feeding mode (large keeled rotaliporids) gradually increased to the maximum in the *Rotalipora greenhornensis* and *R. cushmani* Zones. This trend in foraminiferal strategies indicates a thermal stratification of water column due to input of cold and oxygenated polar waters into oceanic depths.

Advancing warming at the end of Cenomanian produced general anoxia recorded in the Bonarelli-related intervals. The major turn in red marl microfauna composition happened at the Cenomanian/Turonian boundary when the rotaliporids disappeared in the planktonic foraminifer spectrum. The decline of this fauna was caused by general reorganization of the latest Cenomanian oceanic regime, when the thermocline became unstable due to climate warming and subsequent water column homogenization. The rotaliporids settled in deeper part of the water column were exposed to larger ecological stress accompanying the expansion of Oxygen minimum zone up to thermocline. At that time, the opportunistic forms of hedbergellids and heterohelicids became dominant and radiolarian productivity of *Spumellaria* significantly increased.

Besides the productivity peak of the radiolarians, the Cenomanian/Turonian boundary is also marked by pronounced changes in their taxonomic composition. This faunal change occurred in the Superbum Zone, in which the diversified assemblages consist of species like *Acanthocircus tympanum*, *Alievium superbum*, *Crucella cachensis*, *Dictyomitra montisereii*, *Patellula ecliptica*, *Pessagnobranchia fabianii*, *Pseudoaulophacus putahensis*, etc. The Superbum Zone belongs to the lowermost Turonian. Lower Turonian foraminifer associations from red marls above extinction horizon of rotaliporids are characterized by non-keeled descendant morphotypes, like anaticinellids, whiteinellid and praeglobotruncanid opportunistic fauna. Higher up in the Middle Turonian, the keeled morphotypes of foraminifers like dicarinellids and marginotruncanids start to appear.

The Oceanic Anoxic Event 2 is also indicated by several geochemical proxies. In radiolarian-bearing horizons, the organic carbon content increases from 0.30 up to 1.30 %. Stable isotopes imply an increase of the $\delta^{13}\text{C}$ values towards the Cenomanian / Turonian boundary, providing the positive carbon anomaly in the transitional horizons ($\delta^{13}\text{C} = 2.5 \text{ ‰}$). In the same horizons, the oxygen isotopes show a small-scale excursion to the higher negative values ($\delta^{18}\text{O} = - 5.0 \text{ ‰}$). Barium concentration increases in the organic-rich horizons, indicating high-rate export productivity in the OAE 2.

Preliminary report: The revision of genera *Praeleda* Pfab, 1934 and *Praenucula* Pfab, 1934 (Ordovician, Nuculidae, Bivalvia)

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The nuculoids constitute a very successful group of bivalves, especially in the Ordovician. This abstract concerns *Praeleda* Pfab, 1934 and *Praenucula* Pfab, 1934. It is important that *Praeleda* and *Praenucula* general shape of shell is relatively common in the Ordovician rocks

of Spain, France, Wales, southern China, Australia, Argentina, USA and Scandinavia. But also one could hardly find more problematic genera. They are very similar and therefore it is difficult to recognize them well. *Praeleda* and *Praenucula* were described first from the Ordovician of Bohemia. McAlester (1968, 1969) revised the type material of these two genera and included *Praeleda* into the synonymy of *Deceptrix* Fuchs, 1919. McAlester (1969) showed that *Praenucula* differs from *Praeleda* and *Deceptrix* in the anterior and posterior teeth similar in the size and number. Bradshaw (1971) was of the opinion that *Praeleda* is valid and it could be an ancestor of *Deceptrix*. Tunnclif (1982) supposed that *Praeleda* is synonymous with *Deceptrix*. Tunnclif (1982) also described the main features of *Deceptrix* (in his concept) and *Praenucula*, the main difference between *Deceptrix* and *Praenucula* was again in the size of teeth. On contrary, Cope (1997, 1999) proposed that *Praeleda* is valid and described the main features of *Praeleda* and *Praenucula*: in *Praenucula*, hinge plate has an approximately equal number of teeth in anterior and posterior part of the hinge, or in some species the number of the teeth in the anterior part is higher than in the posterior. The anterior teeth may differ little in size from the posterior teeth, or may be markedly larger. Hinge axis is parallel with the dorsal margin and formed by both the anterior and the posterior dentition. In *Praeleda*, the posterior part of the hinge plate is much longer than the anterior and bears variable number of equal-sized teeth. A few of the anterior teeth increase in size anteriorly and there is commonly (but not always) angular discordance between anterior and posterior dentitions. The hinge axis lies along the line of more numerous posterior teeth, and the commonly larger anterior teeth lie ventrally of it. Because of these features Cope (1997, 1999) grouped *Praeleda* into the family Cardiariidae. The anterior line of teeth, which may be enlarged, lie below the hinge axis but the teeth row between the umbones is continuous in contrary to the Ordovician *Cardiolaria* Munier-Chalmas, 1876. Carter (2001) is of the opinion that the presence of anterior palaeotaxodont or pseudotaxodont teeth, abruptly enlarged relatively to posterior palaeotaxodont teeth, is more important for diagnosis of *Cardiariidae*. According to Cope (1999) *Cardiariidae* represents the earliest autolamellibranchs. The differences between *Praeleda* and *Praenucula* were described, but some questions remain. There exist some individuals with transitional type of hinge - in the anterior part they have little enlarged teeth, but they are not enlarged abruptly but gradually (e.g. *Praenucula dispersa* Tunnclif, 1982). In this case it is difficult to distinguish both genera and the possibility that these two genera represent just one genus must be discussed. Enlarged teeth also represent an ecologically important feature - the specimens can burrow deeper into the sediment, making possible larger anterior opening of the shell. Detailed revision of *Praeleda* and *Praenucula* is necessary because they represent evolutionary important genera.

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First evidence of a temnospondyl in the Late Permian of the Argana Basin, Morocco

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Temnospondyl "amphibians" from the Permian of Africa are relatively rare compared with those from the Triassic. Late Permian African temnospondyls are known from South Africa (e.g. *Uranocentron*), Madagascar (*Rhinesuchus*), Tanzania (*Peltobatrachus*), and more recently, Niger (*Nigerpeton* and *Saharastega*). In Morocco, the famous Permian to Early Jurassic Argana Basin (High Atlas Mountains) has been the subject of extensive fieldworks conducted by joint French-Moroccan geological and palaeontological expeditions since the 1960's. Here we present a new temnospondyl specimen recently found by us in the Late Permian Ikakern Formation of the Argana Basin. This fragmentary specimen is a portion of a skull roof; it consists of either articulated left postparietal and tabular (with surrounding bone fragments) or articulated right supratergital and intertemporal (with surrounding bone fragments). The sculpture of the dermal bones combined with either the straight posterior margin of the skull table or the presence of an intertemporal (respectively) suggest a non-stercospondyl and a non-euskelian temnospondyl. This specimen is the first record of a Palaeozoic temnospondyl from North Africa. It is compared with the other temnospondyls from the Permian of Africa. This temnospondyl complete our knowledge on the Permian palaeoecosystem from Morocco which is composed of few plants (e.g. *Voltzia heterophylla*), ichnites (e.g. *Scoyenia* and *Synaptichnium*), and a remarkable tetrapod fauna consisting of a diplocaulid lepospondyl ("*Diplocaulus*" *minimus*), at least one pareisaur parareptile (*Arganaceras vacanti*), and several capthorinid reptiles (*Acrodonta irerhi* and a moradisaurine). The co-occurrence of this temnospondyl with diplocaulid lepospondyl remains and its differences from Late Permian temnospondyls from Niger lend support to a palaeobiogeographical scenario positing amphibian migrations from Euramerica to Africa.

Badenian/Sarmatian boundary in the bivalve record of the Medobory Hills (West Ukraine, Paratethys)

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The Medobory Hills [former Miodobory] are located along the eastern margin of the Carpathian Foredeep Basin that in the Late Badenian was a northernmost part of the Central Paratethys. These hills extend over a distance of ca 150 km and form a distinct belt, well visible in the present-day relief of W Ukraine. This belt consists predominantly of the Upper Badenian coralline algal-vermetid reefs (their thickness in its axial part reaching up to 90 m). The Lower Sarmatian (Volhynian) serpulid-microbialite reefs made-up of unusual assemblage of skeletal organisms (serpulids and bryozoans) and microbialites cover the south-eastern slopes of the Badenian algal-vermetid reefs and seldom overlie their tops. They also occur at the SW foot of the Badenian reef forming isolated, up to few tens meters high mounds. The main frame-builders of the Badenian reefs are crustose coralline algae. Large or tiny vermetid gastropods are also of great importance. Locally, hermatypic corals are significant components of the reef-core facies. These reefs were inhabited by moderately diverse assemblages of gastropods, bivalves, echinoids and crustaceans, among them bivalves are important component. Until now, 55 bivalve species are recognized (Teisseyre 1895, Friedberg 1934-1936). Bivalve assemblage from carbonates have significantly higher proportions of representatives of the subclass Pteriomorpha and lower proportion of representatives of the subclass Heterodonta than those from the surrounding sandy facies latter (Studencka 1994). Carbonate sediment, generally coarse-grained, poor in organic content is the limiting factor for infaunal burrowing suspension-feeders that dominate the Heterodonta and prefer sandy bottom.

At the end of the Badenian, the open marine connection was strongly restricted. This caused that rich and diverse world of the Late Badenian red-algal reefs collapsed and were replaced by significantly impoverished molluscan assemblages. The Sarmatian reef bivalve assemblages contained only 9 species: oyster *Crassostrea gryphoides*, mussels (*Mytilaster volhynicus*, *Musculus sarmaticus*, *M. gatluevi* and *M. voroninae*, the two latter being extremely rare) and cockles belonging to the genus *Obsoletiforma* (*O. vindobonense*, *O. lithopodolica*, *O. sarmatica* and *O. volhynica*, the three latter being highly frequent species). No other genus of the subfamily Lymnocardinae is documented in these microbial-serpulid build-ups. The co-occurrence of serpulids and microbial communities has taken place mainly in ecologically extremely-stressed environments related to anomalous salinity (mainly mesohaline), elevated alkalinity and eutrophic conditions that had profound effect on composition of the bivalve assemblages. In contrast, the bivalve assemblages from isochronous sandy and clayey facies are characterized by higher taxonomic diversity: apart from widespread *Obsoletiforma*, the representatives of cockles belonging to the genera *Plicatiforma* and *Inaequicostata* together with endemic forms of euryhaline families Mytilidae, Cardiidae, Mactriidae, Mesodsmatidae, Semalidae, Donacidae and Veneridae, are documented.

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Oligocene bivalve fauna of the Solenovian type from the Polish Outer Carpathians

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The occurrences of the Oligocene bivalve fauna in the Polish Outer Carpathians are extremely rare (Jucha & Krach 1962). Until now only two localities were recognized: Kobyle III and Gogołów, both representing marine strata of the lowest Oligocene (lower Rupelian).

The peculiar Oligocene bivalve fauna was found in years 2007-2009. The field work undertaken in the Silesian Unit has resulted in the bivalve material derived from two localities near the Jablonica Polska vicinity, about 10 km E of Krosno. The Oligocene bivalve-bearing sequence at Jablonica Polska is distinguished as the Dynów Marls Member, informal unit within the Menilite Formation, directly overlaying the Kotów Czert Member (Kotlarczyk & al. 2006). On the basis of nannoplankton flora the Dynów Marls Member is referred to the NP23 Zone (middle Rupelian). The bivalves occur in marls containing additionally variable clasis. These deposits originated through debris flows.

Our study of the bivalves from Jablonica Polska indicates that they represent a peculiar molluscan assemblage typical for the Solenovian stage of the Eastern Paratethys and the Kiscellian stage (Tard Clays) of the Central Paratethys. This assemblage is characterized in the Eastern Paratethys by the occurrence of highly endemic genera such as *Urbinsia*, *Ergenica*, *Janschinella*, *Lenticorbula*, *Merklincardium*, and *Korobkoviella*.

Bivalve fauna from Jablonica Polska includes ten species, viz.- *Loripes* sp., *Cerastoderma* sp. 1, *Cerastoderma* sp. 2, *Cerastoderma serogosicum* (Nossovsky), *Congeria* cf. *tenuissima* Moiescu, *Lenticorbula* cf. *sokolovi* (Karlovi), *Lenticorbula* cf. *subtriangula* (Moiescu), *Lentidium* cf. *donaciforme* (Nyst), *Lentidium* cf. *ustjurtense* Merklin, and *Janschinella vinogradskii* (Merklin), the last seven of which are characteristic Paratethyan endemics. These are known only from the shelf zones of the Solenovian Sea with pliohaline brackish water oxygenated at the surface and euxinic environmental conditions at the bottom. Until recently, brackish molluscan association typical for the Solenovian Sea was known from the Outer Carpathians only at Piatra Neamț, Romania. According to Rusu (1999), it belongs to the Janschinella garetzkii Zone.

The newly collected material, first of this kind in Poland and second in the Outer Carpathians, is of great importance, both in terms of taxonomic diversity and depositional environments it indicates. This peculiar Solenovian fauna points to reduced salinities of the

sea extending from Bavaria to Transcaspia (Voronina & Popov 1985) and it represents the first real Paratethyan endemic macrofaunal zone around 35 My.

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The Cenomanian-Turonian boundary event in hemipelagic sediments of the Bohemian Cretaceous Basin (Czech Republic) – palynoflora, foraminifera, and calcareous nannofossils record

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Initial transgressive Cretaceous deposits of the Bohemian Cretaceous Basin are represented by siliciclastic sediments of the Cenomanian age (Peruc-Korycany Formation with tree members: Peruc, Korycany and Pecínov) and hemipelagic marlstones and limestones of the Turonian age (Bílá Hora Formation). Transgressive successions include fluvial, marsh, estuarine, inner shelf and open marine facies assemblages (Čech et al. 2005). Generally, character of calcareous nannofossils, foraminifers and palynological assemblages reflects depositional conditions near the Ce-Tu boundary.

Biostratigraphically important angiosperm pollen *Complexiopollis vulgaris* appears in the Peruc Member (late middle Cenomanian, *A. jukes-brownei* Zone) (Uličný et al. 1997). *Palaeohystrichophora infusorioides* and *Spiniferites ramosus* become the most common types and characterize near-shore deposition. The first scarce occurrence of agglutinated foraminifers was recognized in the upper part of the Cenomanian sandstones of Korycany Member. In the inner shelf facies of calcareous clayey glauconitic siltstones of the Pecínov Member mostly agglutinated species and calcareous benthos with sporadic representatives of planktonic genera *Hedbergella* and *Whiteinella* were found. Stratigraphically important species *Gavelinella cenomanica* Brotzen indicates Cenomanian stage of sediments which belong to planktonic interval and partial *Whiteinella archaeocretacea* range zone (upper part of Upper Cenomanian to the lowermost part of Lower Turonian) sensu Robaszynski and Caron (1995). Lithological changes and low oxygen content of the Pecínov Member are reflected in well-pronounced variation within palynological record. Poor dinocyst assemblage, abundant foraminiferal chitinous linings, scolecodonts (jaw apparatus of worms) and amorphous organic matter characterize the uppermost part. Dinocyst species *Epelidosphaeridia spinosa* was found together with *Praeactinocamax plenus* (Upper Cenomanian, *M. geslinianum* Zone) (Čech et al. 2005). Upper Cenomanian foraminiferal assemblage with rare occurrence of planktonic species, a low diversity of dinocyst species,

relatively frequent acritarchs and prasinophytes and poor nannofossils assemblages with higher numbers of *Watznaueria barnesae*, *Bronsonia signata*, and strongly etched specimens, indicate shallow marine conditions at the beginning of transgression (upper part of the Peruc-Korycany Formation).

Influx of abundant nannoflora, very rich, highly diversified dinocyst assemblage supports Turonian transgression and change to neritic conditions. Diverse foraminiferal assemblages with abundance of planktonic keeled type of tests and juvenile specimens with calcareous tests evidenced the conditions of open sea in Lower Turonian. These foraminiferal assemblages belong to *Helvetoglobotruncana helvetica* Zone (Robaszynski & Caron 1995). The presence of calcareous benthos as *Cassidella tegulata*, *Frondicularia inversa* and agglutinated *Gaudryina angustata* Akimec, *G. folium* Akimec is characteristic for the foraminiferal assemblage of this planktonic zone. The lowermost Turonian is well evidenced by first occurrence of *Eprolithus octopetalus* followed by last occurrence of *Helenea chiasia* and first occurrence of *Eprolithus moratus*. First appearance of nannofossil species *Eprolithus moratus* coincides with first occurrence of foraminiferal planktonic species *Helvetoglobotruncana helvetica* in hemipelagic sediments of the Bílá Hora Formation. Dinocyst assemblage with increasing gonyaulaccean types such as *Surculosphaeridium longifurcatum*, *Oligosphaeridium complex*, *Achomosphaera ramulifera*, *Pervosphaeridium pseudhystrichodinium*, *Hystrichodinium pulchrum* and especially open marine form *Pterodinium cingulatum* is most important. Triporate angiosperm pollen from the Normapolles group - *Complexiopollis* and *Atlantipollis* characterize the sediments of the Bílá Hora Formation (Lower Turonian).

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The genus *Stromatocystites* Pompeckj, 1896 (Echinodermata, Cambrian)

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Stromatocystites pentangularis Pompeckj, 1896 - the type species of the oldest genus of the class *Edrioasteroidea* Billings, 1858 has been based on specimens collected from Middle Cambrian sediments of the Teplá-Barrandian Region. Originally, it was described and figured by Pompeckj (1896) from the Týřovice Member of the Buchava Formation (Skryje-Týřovice Basin). Later the species was documented from different stratigraphical levels of the Jince Formation (Příbram-Jince Basin; see Fatka et al. 2004). Skeletal morphology of adult specimens is relatively well known from studies by Jaekel (1899), Schuchert (1919), Cabibel et al. (1959), Termier et al. (1969), Smith (1985), Ubaghs (1998), Parsley and Prokop (2004).

Pompeckj (1896) published several drawings of the oral and aboral surface of excellently preserved specimen, stored in collections of the Czech Geological Survey, which was selected as lectotype by Parsley and Prokop (2004).

Latex casts of external surfaces of the lectotype specimen were photographed for the first time and provided the possibility to study and re-interpret skeletal morphology of theca (e.g. location of the assumed hydropore). *Stromatocystites* is characterized by a domed pentagonal theca composed of several hundreds of tessellate plates. Axial part - ambulacra and the extraaxial part - interambulacral area are clearly differentiated on the oral surface.

Several tens of specimens deposited at the Czech Geological Survey in Prague, in collections of the National Museum in Prague and in private collections made possible to study development of thecal morphology during ontogeny. In agreement with the "EAT" (= Extraaxial-Axial Theory, sensu Mooi et al. 1994), both the axial and extra-axial parts of theca have been separated, starting from the oldest ontogenetic stages. The plate development of the axial part is controlled by the "OPR" (Ocular-plate rule sensu Mooi et al. 2005).

Morphology of theca of *Stromatocystites* fits well with the supposedly benthic suspension feeder attached to the firm un lithified sediments through suction (Dombos 2006).

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Modeling the effects of time averaging on species composition and diversity

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Paleoecological analyses that evaluate spatial or temporal species turnover are affected by between-assemblage differences in temporal resolution (i.e., time averaging) and by other scaling effects that are related to temporal and spatial distance among assemblages and to total temporal and spatial extent of assemblages. Approaches that rescale fossil assemblages having different degrees of time averaging to the same temporal resolution, however, remain underexplored. We model the effects of increasing within-habitat time averaging on the mean species composition, multivariate dispersion of assemblages, and alpha and beta diversity of multiple assemblages. Using 31 datasets with marine benthic (molluscan) assemblages, we generate predictions for time-averaged death assemblages by implementing a neutral, dispersal-limited model of metacommunity dynamics, where semi-isolated local assemblages are surrounded by a large and frozen metacommunity that acts as a source of immigrants. We find that with progressive within-habitat time-averaging: (1) the true (as opposed to sampled) alpha diversity of death assemblages increases because the cumulative probability of immigration by new species increases in time; and (2) the mean species composition shifts in multivariate space owing to the increase in species richness. The decrease in temporal resolution pools dead individuals from successive generations, which leads to (3) a reduction in the proportional abundance of abundant species owing to stochastic switching in the identity of dominant species (owing to compensatory effects that characterize dynamics of living assemblages with steady state rank-abundance distribution); this effect flattens the shape of the rank-abundance distribution and increases the *sampled* alpha diversity; (4) a decrease in the proportional abundances of rare species but an increase in the proportional richness of rare species in the averaged assemblage; and (5) spatial variation in species composition among sites (i.e., beta diversity) is reduced. The power-function scaling exponents for an increase in alpha and a decrease in beta diversity range between 0 and 0.3; exponents decrease with an increase in the spatial scale of sampling. Alpha diversity is inflated on average by 2.1 for death assemblages that have accumulated under 1000 years of within-habitat time averaging, which is similar to but slightly higher than inflation factors observed between molluscan living and death assemblages (1.77).

New groups of scolecodonts in the Silurian of the Prague Basin (Barrandian, Czech Republic)

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The Prague Basin is a geologically well known area with rocks of the Ordovician to Devonian age. These often richly fossiliferous rocks have attracted the attention of scientists

for more than 150 years. Although the level of exploration is high there still remain some questions to answer. New instrumental methods are used and also an approach to taxonomy is changing in time. For example stable isotopic data brings interesting information on the character of the palaeoenvironment (e. g. Lehnert et al., 2007). These data together with the palaeontological and sedimentological findings can give us a complete picture of the palaeobasin.

Revisions of the individual groups of fossils are still proceeding. One of them are scolecodonts which are in the scope of the present research. Scolecodonts represent jaws of the polychaete worms. Thanks to resistance of these jaws, they can be found quite commonly in the fossil record (e.g. Kielan-Jaworowska, 1966).

During the late Silurian the Prague Basin was located in middle southern latitudes. In contrast to palaeocontinents such as Baltica situated in tropical and subtropical latitudes, no reefs are developed, which is in accordance with the predicted cooler water. Nowadays, the most complete data on the scolecodonts are from the Baltic region (see Eriksson et al., 2004). Most distinguished reports on scolecodonts from the Prague Basin are studies of Žebra (1935) and Šnajdr (1951). The revision of collections of these two palaeontologists has already started (Tonarová, 2008) and also new samples from localities Kosov quarry and Liščí quarry are processed. Specimens of the families Paulinitidae LANGE, 1947 and Mochtyellidae KIELAN-JAWOROWSKA, 1966 have been determined. Majority of them were preliminarily assigned to following genera: *Ketmerites* ŽEBERA, 1935, *Mochtyella* KIELAN-JAWOROWSKA, 1961 and *Pistoprion* KIELAN-JAWOROWSKA, 1966. The last two mentioned were not found in Czech Republic before.

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Diversity of Neogene proboscideans in Slovak part of Western Carpathians

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Proboscideans were important elements of Neogene large mammal community in the Slovak territory of the Western Carpathians. Palaeobiogeographical configurations, climatic fluctuations and orogene building radically influenced the taxonomic composition and the ecomorphological diversity of these mammals. Presented study analyses the material from 35

localities in Slovakia, biostratigraphically dated back from lower Miocene (MN 4) to upper Pliocene (MN 17).

The first occurrence of deinothere (*Prodeinotherium cuvieri*) in Slovakia in the Orleanian (Ottangian, MN4) strata is a key palaeobiogeographical and biostratigraphical marker. However, because of the lack of more numerous finds we have only fragmentary data concerning proboscideans diversity from Lower Miocene. From the time span between the Middle Miocene to the Late Pliocene, the findings are more frequent, therefore it is possible to distinguish four distinct periods of proboscideans diversity. The boundary between them marked considerable environmental and faunal turnovers, linked with quantitative and qualitative changes of proboscidean taxa.

1. Astaracian (Late Badenian/Sarmatian, MN 6-MN 7/8) association of proboscidean taxa belongs to two ecomorphological groups - browsers (*Deinotheres*- *Prodeinotherium bavaricum* and problematic taxon *Deinotherium cf. giganteum*) and non-specialized browsers/grazers (trilophodont bunodont taxon - *Gomphotherium* sp. and mammutid - *Zygalophodon turicensis*). Relatively high diversity of taxa indicated variable ecological adaptations to the different niches in subtropical, locally heterogeneous environment.

2. In Early Vallesian (Early Pannonian, MN 9) the considerable palaeogeographic changes took place. They affected the diversity of proboscideans by both the numeric reduction and the quantitative change of taxa. All middle Miocene taxa disappeared and were replaced by immigrated progressive species of typical „hipparion fauna” - *Tetralophodon longirostris* and *Deinotherium giganteum*, which were ecologically adapted to open grassy areas with sparse forests. Representations of both previous ecomorphological groups are continually present, but no Vallesian remains of mammutid taxa are known from Slovakia.

3. Late Turolian (Late Pannonian - Pontian?, MN 12 -13?). Documented three taxa of Turolian “mastodon” assemblages from Slovakia are controversial from the systematic point of view. They are often considered to be either relicts of Vallesian species (*Tetralophodon longirostris*, *Zygalophodon turicensis*), or early appearances of typical Pliocene species (*Anancus arvernensis*, *Mammut borsoni*). According to the study of Markov (2008) they probably represent closely related, but distinct immigrant taxa. Co-existence of these browser/grazer taxa on the same localities indicates their ecological differentiation in feeding habits. Also in this period, the last occurrence of probably strictly browser deinotheres (*D. proavium*) is documented, whose extinction is a result of gradual humidity decrease and disappearance of their particular niche of forest habitats.

4. Two “mastodon” species *M. borsoni* and *A. arvernensis* co-occurred more or less continually from Early Ruscinian (Early Dacian, MN14) up to Early Romanian (MN 16). Their different tooth morphology permits partitioning of the mosaic woodland niches. During the Early Romanian (MN 17), the first occurrence of elephants - *Mammuthus cf. meridionalis* (member of the third ecomorphological group - strictly grazer) is documented, which indicated the gradual spreading and enlargement of open woody steppe biotopes with lowered humidity to the territory of Central Europe. Climatic and drastic environmental changes together with the possible biotic competition of this immigrant progressive taxon could lead to the definitive disappearance of *M. borsoni* and *A. arvernensis*. For the whole period of Pleistocene, only highly specialized taxa of two genera of Elephantidae are present in Slovak fossil record.

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Evolutionary shaping of the temporal region in Chelonia

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Turtles represent an archaic group of amniotes that are unique among reptiles due to their appearance and ecology. Given to the current fossil record, turtles first appeared 220 million years ago in the Upper Triassic (Li et al. 2008), and their descendants have survived numerous biotic crises in almost unchanged appearance until present days (Ernst and Barbour 1989). The shell architecture and axial skeleton adapted to it provide an important source of major diagnostic features of turtles which can be traced back to earliest known fossil turtles (Joyce et al. 2009).

The other specific feature of turtles is their skull, specifically configuration of its temporal region that causes unclear evolutionary position of turtles among reptiles. Unlike previous classification of turtles as anapsid reptiles, recent molecular phylogenetic analyses place turtles within archosaurian diapsids or even in close relationship with crocodylians (Zardoya and Meyer 2001). To examine archosaurian diapsid affinities of turtles, we use comparative developmental morphology of the temporal region in Chelonia and Crocodylia. The methods include histology and computer 3-dimensional reconstructions of cranial structures in two model species – *Chelydra serpentina* and *Alligator mississippiensis*. Developmental topology of skeletal, muscular and nervous components of the temporal region was described, focusing on spatial relationships of neighbouring bones and muscles. Results of this study show principal differences in muscle-bone interactions which give rise to the temporal emargination in turtles and temporal fenestration in crocodylians. The temporal emargination in turtles develops due to spatial constraints by expansion and attachment of their major adductors, as a functional adaptation to support their jaw mechanism. The process of formation of the temporal emargination of turtles does not correspond with development of the temporal fenestration in crocodylians which seems to be formed regardless of spatial constraints by muscles. This can be linked with different jaw mechanism in crocodylians, where the major jaw adductors lie below the level of fenestrated temporal region. In conclusion, our findings imply two independent evolutionary mechanisms of reduction of the dermatocranium in turtle and crocodylian lineages, and thus do not support the position of turtles within archosaurian diapsids.

Evolutionary morphology of the turtle skull will be further interpreted in turtle fossil record, which shows great variability of shaping of the temporal region, probably as evolutionary adaptation to different palaeoecological conditions. Diversification of the temporal region in fossil turtles, with comparison to recent model species, will be studied with use of modern CT and geometric stereometry methods. The aim is to define evolutionary trends in shaping of the temporal region in connection to palaeoecology and origin of turtles.

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Comparison of early growth stages of shell of the Silurian genus *Boionautilus* with the Recent genus *Nautilus* (Nautiloidea)

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Early ontogeny of the Silurian nautiloid *Boionautilus* Turek, 2008 (Tarphyocerida, Barrandeocerina), a representative of the suborder including presumable ancestors of recent nautilids (Dzik and Korn 1992), is compared with early ontogeny of the Recent *Nautilus*. As the neponic constriction of shell characterising the end of embryonic stage of post-Triassic nautilids is missing in the genus *Boionautilus*, it is necessary to use other features characterising embryonic shell of the Recent *Nautilus* (see Stenzel 1964, Arnold, Landman and Mutvei 1987, and Chirac 2001).

The change of the shell coiling is remarkable in the juvenile stages of *Boionautilus*. While the earliest shell is only slightly curved, later it suddenly changes direction of growth. Umbilical perforation is therefore drop-like elongated. Growth lines are the dominating feature of the surface sculpture and a fine reticulate sculpture persists also in later growth stages in many specimens. Hyponomic sinus develops gradually; it is already clearly defined in the first half of the whorl consisting of already of 7–8 phragmocone chambers. Increasing roughness of sculpture, irregularities in spacing of growth lines, striking deepening of the hyponomic sinus, eventual appearance of annulation and first injuries are the main features suitable for determination of a probable border between embryonic and postembryonic growth stages (i.e. hatching time). These changes seem to coincide with the abrupt change of the shell coiling. The length of the shell is 11–13 mm in this stage, i.e. approximately in 1/6 of the whorl. The first marked repair of injured shell appears in the half of the first whorl.

Embryonic shells are known in three species of the genus *Boionautilus* forming an evolutionary lineage *B. sacheri* – *B. tyrannus* – *B. bohemicus* ranging from the upper Ludlow to upper Přídolí (Turek 2008). Morphological changes observed in early juvenile shells are expressed in tighter coiling of the first whorl and appearance of annulation in postembryonic phase of ontogeny in *B. sacheri*. *B. bohemicus* frequently differs from *B. tyrannus* by more rapid increasing of dorsoventral length of early shell. Widely cup-shaped protoconch is low, its height is, however, highly variable, what is expressed in length of the caecum. Following chamber is usually higher than the third one. The height of the phragmocone chambers thus gradually increases. Early hatched shell in *Boionautilus* had, beside the protoconch, only one or two phragmocone chambers. This is possible to suspect from the relative length of the juveniles and distance of the first three septa.

Hatched *Boionautilus* resembles not yet fully developed embryo of the Recent *Nautilus*. The short phragmocone apparently was not sufficient to buoy relatively thick-walled shell. Juveniles after hatching therefore very probably shortly dwelt near the bottom. Owing to increasing volume of phragmocone accompanied by a quick development of the hyponome, the animal gained soon an active swimming ability. The youngest shells found reach 1/2 of the whorl (growth stage relatively far beyond hatching) may indicate low mortality of freshly hatched animals. The high regeneration ability of juveniles proves healed serious shell damages appearing already in 3/4 of the first whorl.

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“Preliminary report on *Palaeoaldrovanda splendens* carnivorous plant or insect eggs?”

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Palaeoaldrovanda splendens Knobloch et Mai (1986) is interpreted as one of the earliest records of carnivorous plants. However its nature is controversial. It comes from the Kvikov Formation (Upper Turonian – Santonian), which forms a basal part of the South Bohemian Basins. There are three main lithological types: Light grey or yellow sandstone beds, red beds composed of sandstone, sandy mudstone and sandy claystone, gray beds and grey beds composed of sandstone and claystone (Slánská 1976).

Specimens of *Palaeoaldrovanda splendens* are preserved as charcoal. The nearest living relative of *P. splendens* would be *Aldrovanda vesiculosa* L. (Droseraceae), which is rootless, free-floating a critically endangered aquatic carnivorous plant growing in shallow standing waters (Adamec 1995). Seeds of recent *Aldrovanda vesiculosa* and fossil *Palaeoaldrovanda splendens* were compared and large differences were discovered.

Whole specimens of *P. splendens* are about 1 mm long. They are elliptical in shape and their outer surface is shiny. Seeds of *A. vesiculosa* have also an elliptical shape and shiny outer surface, but micropylar area of *A. vesiculosa* is round, exhibiting a micropylar plug inside. In the case of *P. splendens* this area is only a round projection having a compact structure. Hilum is in the case of *A. vesiculosa* only slightly pointed. In the case of *Palaeoaldrovanda splendens* it is an irregularly formed projection exposed. This indicates that the fossil *Palaeoaldrovanda splendens* is probably not a relative of the recent *Aldrovanda vesiculosa*. Structures like the round apical and basal projections in the case of *Palaeoaldrovanda splendens* are very unusual among fossil seeds and occur at insect eggs. Some members of the order Phasmatodea oviposit eggs with operculum, which is very similar to the structure found in the holotypes of *P. splendens*.

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Taphonomy of the Upper Devonian vertebrate bonebeds at Langsēde Cliff, Latvia

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The most ancient tetrapods ever found come from the Upper Frasnian: *Elginerpeton pancheni* from Scat Craig in Scotland, and *Obruchevichthys gracilis* from Latvia and Russia, both species being represented by very fragmentary material. The holotype of *Obruchevichthys* was found in the Ogre Formation, cropping out at Velna Ala (Devil's Cave) by the river Abava, and attributed by Vorobyeva to osteolepiform fishes.

The Langsēde cliff, known as a rich fossiliferous locality, is situated 4,2 kilometres to the west from Velna Ala. Deposits of the Ogre, Stipinai and Amula formations crop out here. Excavations at the Langsēde site were organised in 2008; the expedition team included representatives of the University of Latvia, the Natural History Museum of Latvia and Uppsala University. Abundant vertebrate remains have been found in the middle part of the Ogre Formation.

These remains are present mostly in a 20-40 cm thick conglomerate bed, which is rich in pebble-sized clay rolls and clay inclusions of irregular shape. Conglomerate overlies the clayey to sandy deposits with current ripple lamination and burrows, and it is covered by through-stratified fine-grained sandstone. Thickness of cross-stratified beds decreases upwards, while the abundance of mud drapes on cross-strata increases. Fine-grained sandstone with current ripple-lamination follows upwards. Conglomerate-to-sandstone sequence likely corresponds to gradual infilling of the tidal channel, and the vertebrate bonebed lies on the bottom of the channel.

More than 650 vertebrate fossils have been unearthed and 550 specimens determined to the generic/species level. In comparison with the full list of vertebrates of the Pamūšis Regional Stage of the Baltic States and NW Russia, the faunal composition of the assemblage from the Langsēde site is rather scanty. Eight genera belonging to four groups (heterostracans, placoderms, acanthodians and sarcopterygians) have been identified. Neither remains of *Obruchevichthys* nor other tetrapods are found so far at the Langsēde site.

The placoderm *Bothriolepis maxima* markedly dominates the vertebrate assemblage; then psammosteids and sarcopterygians follow, and the macroscopic remains of acanthodians are scarce. The specific distribution of the fossils of different size has three obvious maxima. The first maximum is associated with sarcopterygian scales; placoderm bones are predominant among the fossils within the second and the third group. Size distribution of the placoderm bones may demonstrate approximately uniform age of fishes within the assemblage.

Vertebrate remains are represented mainly by fully disarticulated placoderm and psammosteoid plates and plate fragments, sarcopterygian scales and teeth. The remains are well preserved, but articulated bones are rare; yet there are complete distal segments of pectoral fin and head shield of placoderms, as well as lower jaw of a sarcopterygian among them. The anterior median dorsal plates, posterior median dorsal plates and posterior ventral lateral plates are best represented among the skeletal elements of *Bothriolepis maxima*; other skeletal elements are underrepresented.

The degree of destruction and disarticulation of the bones shows that carcasses have undergone transportation or have been rewashed before the final burial. Convex bones mainly

lie in a hydrodynamically stable position in the northern part of the excavation area, whereas in the southern part of the area the number of bones lying with their concave surface upwards increases. The horizontal distribution of the bones is not homogeneous; there are distinct linear zones oriented almost perpendicular to the dominant dip azimuth of cross-strata and ripple-laminae in the Ogrze Formation. Probably such distribution of the bones may show that they were concentrated in the depressions between the subaqueous dunes. The vertebrate remains have been most probably deposited in the shallow sea environment on the bottom of a tidal channel under the influence of rapid water currents.

The Basic System of Early Cretaceous Ammonites and the Current Standard Ammonite Zonation in the Western Carpathians

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Until recently the order Ammonitida Agassiz 1847 was divided into four suborders: Phylloceratina Arkell 1950, Lytoceratina Hyatt 1889, Ammonitina Hyatt 1889 and Ancyloceratina Wiedmann 1966. Vermeulen (2006) divided the suborder Ancyloceratina, including so-called heteromorph ammonites, into three suborders: Protancyloceratina Vermeulen 2005, Ancyloceratina Wiedmann 1966 (emend.) and Turrilitina Beznosov & Michailova 1983.

The standard zonation of Early Cretaceous deposits of Mediterranean bioprovince has developed in the period of last twenty years. The latest version is given in a report by Reboulet & Klein et al. (2009).

In the Slovak territory, Early Cretaceous ammonites occur abundantly in the Central Western Carpathians, especially in the deposits of Křížna Nappe and its equivalents; in the Czech territory then in the Outer Western Carpathians in the deposits of Silesian Nappe.

From the point of view of ammonite occurrence, the Early Cretaceous sequence of strata in sections of the Butkov Quarry near the municipality of Ladce (Manín Unit) is documented best. The pelagic carbonate sequence of that place is continuously evidenced by zone ammonites in the later Early Valanginian to earlier Late Barremian period.

At Butkov, the following ammonite zones are evidenced either by the direct occurrence of zone species or guide horizon (printed bold) or by the zone ammonite association: **Busnardoites campylotoxus** – latest Early Valanginian (Ladce Formation), Saynoceras verrucosum – basal Late Valanginian (Ladce Fm), Neocomites peregrinus – Late Valanginian (very rich association in Ladce Fm), **Criosarasinella furcillata** – latest Valanginian (very rich association in Mráznica Formation), Acanthodiscus radiatus – basal Hauterivian (Kališčo Formation), **Crioceratites loryi** – Early Hauterivian (Kališčo Fm), Lyticoceras nodosoplicatum (**Olcostephanus variegatus**) – latest Early Hauterivian (Kališčo Fm), Subsainella sayni – basal Late Hauterivian (Kališčo Fm), **Plesiospitidiscus ligatus** – Late Hauterivian (Kališčo Fm).

Although no interruption in sedimentation occurred, other zones of Late Hauterivian and basal Barremian at the Butkov Quarry (Lúčkovská Fm) are not documented by guide ammonites. Higher Late Hauterivian Zone with Balearites balearis is evidenced well by a section at the Polomec Quarry near Lietavská Lúčka. Nevertheless, neither Hauterivian/Barremian boundary deposits are evidenced by ammonites there.

Further, in the Barremian of Butkov a rich ammonite horizon occurs; it belongs to the **Kotetishvilia compressissima** Zone (Early Barremian). The latest ammonite zone found at Butkov is evidenced by the occurrence of *Toxancyloceras vandenheckii*, which indicates the basal Late Barremian zone of the same name, **Vandenheckii** Zone.

A different situation is characterised by ammonite associations of Early Cretaceous in the Silesian Nappe of Outer Western Carpathians. The Early Cretaceous of this place is represented by a thick complex of grey to dark grey pelitic deposits with nodular clay ironstones. Merely deposits of later Early Barremian to earlier Early Aptian (Hradiště Fm) are rich in ammonites.

The oldest documented ammonite zone in the Silesian Nappe is the Early Barremian **Nicklesia pulchella** Zone. By the zone species, the subsequent **Kotetishvilia compressissima** Zone is evidenced as well. The latest zone of Early Barremian (Moutoniceras moutonianum), the zones of all Late Barremian and basal Aptian (*Deshayesites oglanensis*) can be derived merely on the basis of overall composition of ammonite associations; however, zone species are missing here.

Paleontology and sedimentology of the Lower Badenian profile at Kralice nad Oslavou (Carpathian Foredeep, Czech Republic)

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Near Kralice nad Oslavou, an erosional relic of marine Neogene sediments on the crystalline rocks of the Bohemian Massif, documenting the actual extent of the Carpathian Foredeep, and the post-depositional uplift and erosion processes, was first described by Procházka (1893), and later studied, among others, by Koutek (1971), Hamršíd (1984), Sváček (1995), Žágoršek & Holcová (2003), and Žágoršek et al. (2007).

Three outcrops were studied on the left bank of the Jimošov creek: Kralice-I (49° 11.619' N, 016° 12.493' E - nonfossiliferous greyish claystones), Kralice-II (49° 11.591' N, 016° 12.516' E - yellowish sandstones, mainly with foraminifers; Žágoršek et al. 2007), and Kralice-III (49° 11.584' N, 016° 12.538' E - yellow marls with foraminifers; Žágoršek et al. 2007), and bryozoans, foraminifers, molluscs, and echinoderms; Žágoršek et al., in print).

The foraminifers from the profiles Kralice-II and III belong to the lower part of the Upper Lagenid Zone (Lower Badenian – Langhian); the calcareous nannoplankton is characteristic for the zone NN5.

The base of the section (Kralice II) originated in the low-neritic marine paleoenvironment below the fair-weather wave base, probably influenced by storms or density flows/gravity

currents, in well oxygenated bottom waters. In this interval, asteroids, echinoids, molluscs, and bryozoans are mostly rare or with low diversities, whereas nannoplankton, and foraminifers reveal high diversities, and abundances.

Upwards (lower part of Kralice III), molluscs, foraminifers, and abundant Rhodophyta indicate deeper infralittoral conditions, with maximum palaeodepths perhaps more than 100 m (marine/offshore settings with an episodic input of coarser material from the coast - gravity currents or storm induced flows / tempestites). Foraminifers, nannoplankton, molluscs and asteroids show the abundance peaks in this part of the section, bryozoans and echinoids are rare, sometimes almost absent, probably due to the decrease of oxygen content inside the bottom sediments.

Considerably changed conditions (changes in the basin geometry and/or source area, an increased volcanic activity in the hinterland, episodic storms or density flows/gravity currents and down-slope transport of shallow-water sediments), and a generally shallowing upwards trend are interpreted in the uppermost part of the section (= upper part of Kralice III). Echinoderms, bryozoans, and molluscs are abundant in this interval, whereas the abundances of Rhodophyta, Foraminifera and calcareous nannoplankton decrease upwards. The fauna generally indicates a relatively dynamic shallow-marine environment with normal salinity, high oxygen levels, and perhaps sea grass meadows.

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Sarmatian sediments from the vicinity of Pernek (Western rim of the Malé Karpaty Mts.)

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On the western outskirts of the Malé Karpaty Mts. the sediments of the Sarmatian age are cropping out to the surface. Their occurrences have been known from this territory since the second half of the 19th century. They were described by Paul (1863), Adrian and Paul (1864)

and Vetter (1904) from the vicinity of surrounding villages Prievaly (Sandorf) and Sološnica (Breitenbrunn). In the 30ties of the last century the geological mapping detected the Sarmatian sediments north of the village Pernek (Kodým & Matějka, 1936; Matějka & Kodým, 1937). More detailed knowledge of the Sarmatian sediments at the west edge of the Little Carpathians was acquired in the course of geological mappings for the general map of Czechoslovakia at scale 1: 200 000. It was found that the sediments of the Sarmatian age in this area occur in two more-or-less coherent stripes at Sološnica and between Plavecký Mikuláš and Prievaly (Buday et al., 1962). These sediments were studied in the past for microfauna (Cicha, 1957) and macrofauna (Švagrovský, 1971) content and heavy minerals, as well (Uher & Kováč, 1993).

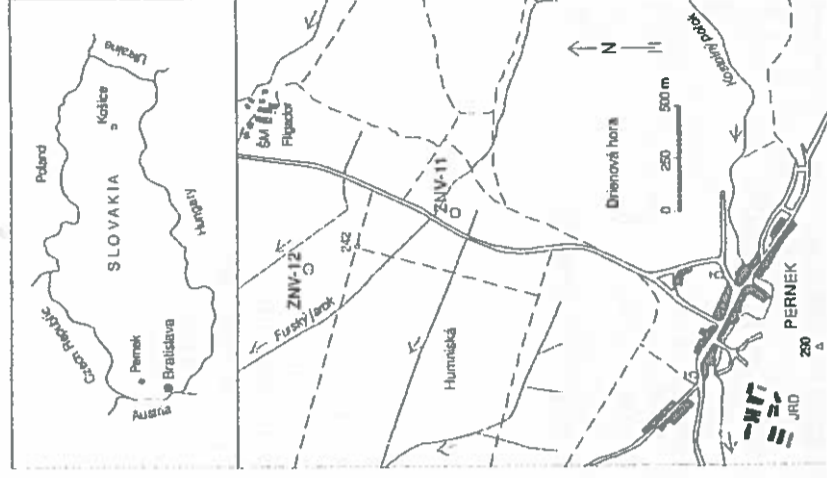


Fig. 1 Localization of the boreholes ZNV-11 and ZNV-12.

In the scope of the geological mapping of the Záhorská nížina Lowland north of the village Pernek two shallow exploration boreholes ZNV-11 and ZNV-12 (Fig. 1) were realized. Their aim was to verify a presence of the Sarmatian sediments in this area, identified for the first time during the geological mapping in 1936 (Kodým & Matějka, 1936; Matějka & Kodým, 1937), because the next mapping campaign in the 60ties of the 20th century did not confirm their occurrence (Baňacký & Sabol, 1973).

The boreholes ZNV-11 (7.0-12.7 m) and ZNV-12 (0.3-3.0 m) recovered the sediments formed by grey-green, brown and mottled clays. In the samples foraminifers *Articulina sarnatica* (Karrer), *Ortomorphina dina* (Vengl.), *Elphidium josephinum* (Orb.) were identified, which confirmed the Sarmatian age of the above deposits.

In the samples from the borehole ZNV-12 the nanofossils of the Upper Cretaceous and Palaeogene age (particularly Eocene) were found, and these constitute about 90 % of the association. Nanofossils of the older layers of Middle Miocene (e.g. *Sphenolithus*

heteromorphus Deflandre) were identified. In the associations, we found nanofossils taxa with stratigraphic range from Palaeogene till Middle, for example *Discoaster deflandrei* Bramlette & Riedel, *Coccolithus pelagicus* (Wallich), *D. exilis* Martini & Bramlette, *D. variabilis* Martini & Bramlette and *Calcidiscus leptoporus* (Murray & Blackman) range from the Early to the Middle Miocene in the Western Carpathians region.

In the studied samples, the nanofossils association with the dominance of species *Reticulofenestra pseudumbilicus* (Gartner) Gartner ($> 7 \mu$) was found. In addition to the above mentioned taxon, the species present in the association included *Calcidiscus pataecus* (Gartner) de Kaenel and Villa, *C. leptoporus* (Murray & Blackman) Loeblich & Tappan, *Coccolithus pelagicus* (Wallich) Schiller, *Discoaster deflandrei* Bramlette & Riedel, *D. variabilis* Martini & Bramlette, *D. exilis* Martini & Bramlette, *Rhabdosphaera sicca* Stradner, *Braarudosphaera bigelowii* (Gran & Braarud) Deflandre, *Thoracosphaera* sp. and *Perforacalcinella fusiformis* Bóna. The character of the association could confirm the Sarmatian age of the studied sediments.

In the sample from the borehole ZNV-11 from the depth range 12.5-12.7 m, pollen grains of genera *Pinus*, *Ulmus*, *Quercus*, *Quercus ilex* were found, along with *Cathaya* and Taxodiaceae families. This association indicates the presence of mesophytic mixed forest and at the same time the elements of floodplain or swamp vegetation. The presence of evergreen and thermophilic forms (*Quercus ilex* type, *Cathaya*) indicates likely subtropical conditions. The presence of fall-of oak forms suggests the possibility of onset of climate oscillations at least in terms of seasonal changes in average precipitation, which are typical for the end of the Middle Miocene.

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GUIDBOOK OF EXCURSION

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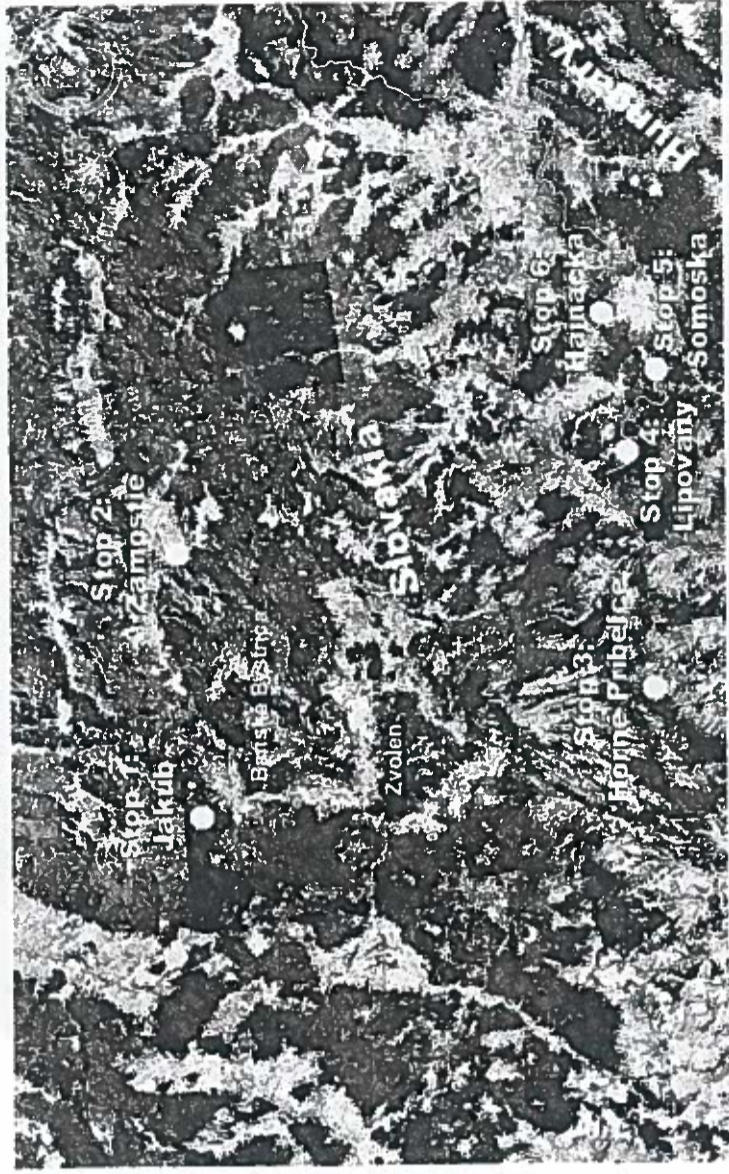


Fig. 1 Geographical position of the visited localities in the frame of the 10th Anniversary conference of the Czech, Polish and Slovak Paleontologists.

Stop 1: Jakub

Co-ordinations: 48° 46' 19.74" N; 19° 07' 50.47" E.

Triassic-Jurassic sequence of the Křížna Nappe near the Jakub village. The section is situated in the SW part of the Starohorské vrchy Mts., in vicinity of Banská Bystrica.

The Jakub section provide opportunity to study the Rhaethian/Hettangian passage beds. The Rhaethian part of the section is represented by the Svätý Jakub Formation, which consists of the massive light-grey limestones. Their microfacies are mostly pelmicritic, pelspartic and biomicritic. These coprolithoclastic and bioclastic limestones contain fecal pellets of *Parafavreina thoronetensis*, foraminifers *Aulotortidae*, echinoderms, etc.



Fig. 2 Locality Jakub composed of two outcrops.

The Svätý Jakub formation is overlain by the rhythmical-bedded limestones of the Nový Svet Formation. In contrast of scarce fossils in the Svätý Jakub Formation, the Nový Svet Fm. is rich in pectinid bivalves (*Chlamys textoria*), brachiopods (*Lobothyris*), oysters (*Gryphaea* sp.), sponge spicules, etc. The transition from the Svätý Jakub Fm. to the Nový Svet Fm. coincides with the Triassic/Jurassic boundary, which represents one of the five largest Phanerozoic mass extinctions.

Liassic part of the Jakub section is also remarkable from phylogenetic point of view of the brachiopod fauna. The Lower-Middle Hettangian post-extinction brachiopods dominated by the monospecific fauna of *Lobothyris* community. This fauna was replaced by a community of the terebratulid *Zeilleria*, multicostate rhynchonellids *Jakubirhynchia* and oysters. Hettangian brachiopod communities therefore reflect the deepening upward trend after the end-Triassic mass extinction.

Bivalves:

Chlamys (Chlamys) textoria (Schlotheim),
Plagiosstoma aff. *punctatum* (J. Sowerby),
Gryphaea sp.

Brachiopods:

Zeilleria perforate
Jakubirhynchia latifrons

Ammonites:

Kammerkarites haploprychus
Lobothyris adleri

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Fig. 3. The view on the Jakub section near Banská Bystrica. The massive grey limestones of the Svätý Jakub Fm. (Rhaethian) in lower part of the picture, superimposed by a well-bedded yellow-grey limestones of the Nový Svet Fm. (Liassic).

Stop 2: Zámostie Valley – the Štefánka locality

Co-ordinations: 48° 49' 28.54" N; 19° 25' 59.28" E.

The sequence building northern side of the Hron Valley (foothills of the Nízke Tatry Mts) around Nemecká and Predajná villages was studied by Štúr (1868) who designated it as the Middle Triassic „Muschelkalk-Dolomit“. Although his dating was correct, the geological structure of the area is much more complex (Kochanová and Michalík, 1986). Triassic carbonate complexes, belonging to the Biely Váh of the Choč Nappe, recorded a complicated tectonic history of Anisian and Ladinian sedimentation in the Hronic Domain of the Western Carpathians.



Fig. 4. Locality the Zámostie Valley - the Štefánka section.

The sequence exposed starts with the *Farkašovo Megabreccia*, composed of decimeter – to 6-meters sized more-or-less dolomitized Gutenstein limestone blocks, enclosed in fine detritic dolomitic matrix. Total thickness of this complex is hard to estimate. It is probably changeable, reaching up-to hundred meters. The megabreccia represents products of eroded and collapsing trench margins, splitting shallow carbonate shelf during top-Anisian rifting.

The fill of originating depressions starts with the *Jasenie Limestone Member* of the *Zámostie Formation*. It consists of black organogeneous slightly silicified biomicrite, containing selectively silicified remnants of brachiopods (*Piarorhynchella*, *Mentzelia*, *Aulacothyris*), bivalves, gastropods (*Siraparollus*, *Promathilda*, *Polygyrina*, *Zygopleura*, *Dicosmos*), dentalids, polychaetes, ammonites (*Balatonites*, *Norites*) and crinoids. The microfauna is represented by holothurians, foraminifers and conodonts. The association of these organisms probably lived in open shallow marine lagoons. The age was precised as the Pelsonian according to ammonite finding of *Balatonites balatonicus* (Rakús, 1986).

The successive *Ráztoka Member* is composed of ash-grey rather recrystallized biosparite with bivalve fauna and with fillings of probably crustacean burrows of the *Spongeliomorpha* type. Occasional oblique stratification indicates the sedimentation in a calcarenite bar environment.

The higher lying *Reifling Formation* represents sediment of relatively deep bottom of tensional intra-shelf depressions. It is exemplified by well-bedded silicified cherty micrites with nodular planes (the „Knollenkalk“) and by thick- to almost massive micrites with dispersed chert nodules (the „Bankkalk“). The limestone contains a microfauna of conodonts, foraminifers (Jendrejáková et al., 1981) and ostracods.

The limestone sequence was abruptly covered by black, brown weathering claystones of the *Lunz Formation*. Marine fossils were found only close to the base: the higher part contains terrestrial plant fragments and sporomorphs only. Sudden clastics support into carbonate basin indicates rapid increase of erosive- and transport power of river streams in abrupt climatic change conditions during earliest Late Triassic. After end of this event, the carbonate sedimentation, represented by the *Hauptdolomit*, continued.

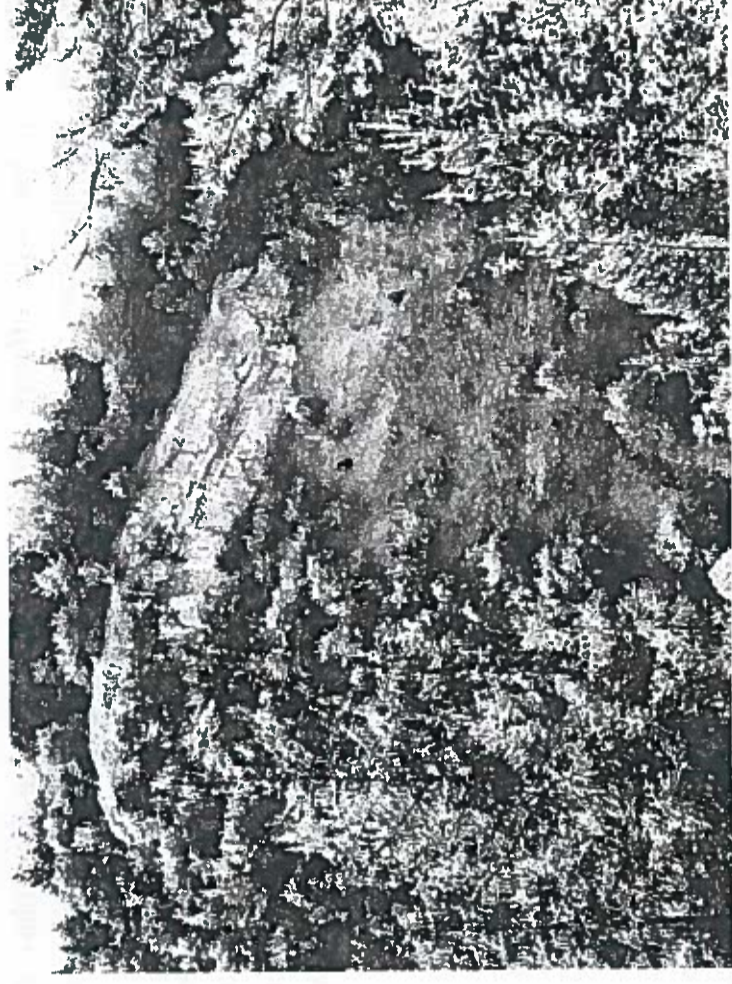


Fig. 5. Reifling limestone sequence in the Zámostie Valley - the Štefánka section.

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Stop 3: Horné Príbelce

Co-ordination: 48° 11' 51.50" N; 19° 14' 43.56" E.

The studied outcrop is regarded as the stratotype section of the Príbelce Formation, which represents a shoreface sands of the Ipeľ Basin, cropping out near Horné Príbelce, Dolná Strehová, Klečany, etc. The Príbelce Sands overlain the Karpatian sediments of the Modrý Kameň Fm. and they are superposed by volcanoclastic sediments of the Vinica Fm.

The Príbelce Formation reveals the Lower Badenian age. The formation consists of the sediments of longshore bars with different types of cross-stratification, lenticular-, flaser-, megafaser- and wavy bedding, giant ripples and deformational structures. By this structures, the Príbelce Formation resembles the delta-shallow-marine complex.

The Príbelce Formation contains the marine fauna like lamellibranchians, gastropods, corals, etc. The most obvious faunal elements are represented by shark and mammal teeth (Chondrichthyes, Mammalia, Vertebrata – Holec, 2004). Eleven taxa of selachian teeth and two mammal teeth of Cervids have been recovered from the Príbelce Fm. (Holec, 2004). The selachians assemblage includes pelagic and also benthic species.



Fig. 6 Sand pit on the NW margin of Horné Príbelce village.

List of the vertebrate fauna:

Sharks

Notidanus primigenius
Odontaspis acutissimus
Mitsukurina sp.,
Triaenodon obesus
Isurus hastalis
Isurus retroflexus
Carcharocles megalodon

Hemipristis serra
Carcharhinus cf. priscus
Galeocerdo aduncus
Aotobatus sp.

Mammalia

Cervidae – premolar gen. et species indet.
 incisor – undetermined taxa

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Stop 4: Lipovany

Sand pit

Co-ordinations: 48° 12' 54.72" N; 19° 42' 33.13" E.

The locality exhibits the Lower Miocene sediments of the Filákov-Pétersvársára Basin. There is a sand-pit south of the village, where the Lipovany Sandstones of the Filákov Formation occurred. The sandstones has grey color, they are laminated and cross bedded. They contain scattered pebbles, storm sediments (conglomerate-bearing coquinas) and spheroidal concretions.

The Lipovany Sandstones contain very rich marine molluscs, mainly thick-walled ostreids and pectinids. The Eggenburgian age is confirmed by species of *Pecten pseudobeudanti*, *P. benedictus*, *P. hornensis*, *Chlamys gigas*, *Ch. palmata*, *Glycymeris fichteli*, *Cardita zelebori*, *Cardium burdigalinum*, *Lutraria sanna*, etc. (Ondrejčková, 1972). Microfaunistic components are represented by poor foraminifers, involving typical index taxa of the Eggenburgian, like *Uvigerina poshtankeni* (Zlinská & Šutovská, 1990). The association of calcareous nannoflora contains among others also index form of the NN 2 Zone *Discoaster druggi* (Lehotayová in Vass et al., 1986). The Lipovany Sandstones are overlain by the calcareous siltstones of the Čakanovce Member.



Fig. 7. Locality Lipovany.

Gravel pit

Co-ordinations: 48° 13' 34.05" N; 19° 42' 55.55" E.

Second locality in vicinity of Lipovany occurs closer to the state boundary. There is a small gravel pit, in which the alluvial gravels and sands of the Bukovinka Formation crop out. These marine and continental sediments are overlain by coal seams and rhyolite tuffs with abundant leaf imprints of subtropical and tropical rain forest plants (palms, laurels, mahonlias, conifers, oaks and others). These tuffs and coal sediments belong to the Šalgótárián Formation (Early Miocene – Otnngian).

Stop 5: Šomoška

A National Nature Reserve extending over an area of 36,62 ha. 1,6 km long tourist and educational trail enables to visualise the peculiarities of this area, such as hydrophytic plants and fauna of the Bukovinka creek, the old beech forest on the castle hill and geologic, as well as historic attractions. There is a small outcrop along the path, showing marine sandstones of the Fiľakovo Formation, penetrated by a basaltic neck (fill of a feeding channel), which is preserved on the castle hill. On the eastern slope of the hill, basalt with unique, slightly twisted columnar jointing, can be seen. On the western side of the hill columnar jointing is horizontal, i.e. perpendicular to the original wall of the supplying channel (neck margin). The rising of columns at the eastern slope indicates the transition into a short lava flow or into the crater fill in form of a lava lake. The age of the basalt is $4,06 \pm 0,06$ Ma (Early Pliocene). The basaltic body has been intensively weathered during the Quaternary, as indicated by stone

fields on the slopes of the castle hill. A part of stones are debris falling down from the castle wall ruins.

The originally gothic castle on the top of the hill was built in 13th – 14th century from basalt columns. The castle belonged to the Kačič, Széchnyi and mainly to the Losonczy families. It was captured by the Turks in 1576. The castle sustained its original character until the beginning of 20th century, but later deteriorated. The reconstruction Works starting in 1972 continue, with short breaks, until the present days. Artificial water reservoirs in the valley were constructed during the twenties of the last century.



Fig. 8. Gothic Castle Šomoška. Author CIVERTAN

http://upload.wikimedia.org/wikipedia/commons/d/d4/Somoška%25%91_-_castle.jpg

Stop 6: Hajnáčka

Co-ordinations: 48° 12' 36.35" N; 19° 57' 46.16" E.

Fossiliferous layers are exposed in deep erosive furrows within an elliptically shaped maar depression (the Bone Gorge maar, the Cerová Basalt Fm.) at the northern foothills of Matrač Hill about 1.200m SE of Hajnáčka village near the town of Rimavská Sobota in Southern Slovakia. The fossiliferous complex consists of autochthonous tuff, lapilli tuffite, fragments of basalt, and fine sand with underlying redeposited Eggenburgian sandy sediments (the Fiľakovo Fm.). Quaternary loamy and loam-argillaceous deposits cover this complex.

Hajnáčka is a classical vertebrate locality attributed of the MN 16a zone (Early Villanyian, Late Pliocene). A palaeomagnetic measurement dates maer and its fillings to a period of Gauss magnetic chron (C2An).



A pioneer field-works are dated to the 19th century, when Emil von Ebeczky collected accidental skeleton remains of mastodons and tapirs. A systematic excavation in 1955 led by Prof. Fejfar focused mainly to the determination of the exact age of Hajnáčka fossil assemblage and its palaeoenvironment. The last field-research of the site has been so far realized by the Gemer-Malohont Museum in Rimavská Sobota from 1996 to 2000.



Fig. 9. Location of Hajnáčka I palaeontological site (according to Fejfar 1964, modified).

Fossil assemblage

Fossil flora assemblage consists of macroflora and pollen remains. The pollen record with arctotertiary geofloristic elements with the botanical affinity to *Abies* sp., *Picea* sp., *Sciadopitys* sp., *Tsuga* sp., *Pinus* sp., less *Carya* sp. and *Acer* sp. represents a vegetation cover in the neighbourhood of the maar during the forming of its primary fill. The fossil macroflora from deposits of the secondary maar filling indicates the presence of mixed mesophytic forest with the dominance of *Quercus*, *Tilia*, *Ulmus*, *Acer*, and *Torreya*, whereas shrub layer included mainly evergreen forms (*Buxus*) and lianas (*Vitis*).

Fossil fauna is much abundant, consisting so far of molluscs (*Anodonta* sp.), ostracods (*Darwinulla* sp., *Ilyocypris* sp., *Candona* sp., and *Pseudocandona* sp.), fishes (*Scardinus* ?*erythroththalmus*, *Scardinus* sp., *Tinca furcata*, *Tinca* sp., *Esox* sp., ?*Parasilurus* sp., Percidae indet.), amphibians (*Pliobatrachus* sp., *Bufo bufo*, *Rana* cf. *temporaria*, *R.* cf. *arvalis*, *R.* cf. ex gr. *dalmatina-latastei*, *Anura* indet.), reptiles (*Chelydra* aff. *decheni*, *Emys orbicularis*, *Testudinata* indet., *Serpentes* indet.), birds (*Mergus* sp.), and mammals (*Hypolagus brachygnathus*, *Lagomorpha* indet., *Sciurus* sp., *Pliopetaurista pliocaenica*, *Castor fiber* ssp., *Trogontherium minus*, *Apodemus* sp., *Baranomys loczyi*, *Mimomys hassiacus*, *M. stehlini*, *Mimomys* sp., Arvicolinae indet., *Germanomys* sp., *Ungaromys* sp., *Prospalax priscus*, *Selevimiidae* indet., *Megantereon* sp., *Hyaena perrieri*, Ursidae indet., *Lutra* cf. *bravardi*, *Parailurus hungaricus*, *Talpa* cf. *minor*, *T. fossilis*, *Talpa* sp., *Desmana nehringi*, *Deinsdorfia hibbardi*, Soricidae indet., *Petenya hungarica*, *Beremendia fissidens*, *Blarinoides mariae*, *B.* cf. *mariae*, Colobinae indet., *Sus minor*, Cervidae indet., *Muntiacus* sp., *Cervus perrieri* – *Arvenoceros ardei*, *Cervus pardinensis*, *Croizetoceros ramosus*,

Capreolus sp., *Dicerorhinus jeanvireti*, *Dicerorhinus* sp., Rhinocerotidae indet., *Tapirus arvernensis*, *Mammot borsoni*, and *Anancus arvernensis*). The found vertebrate assemblage lived in steppe or open grassland to bushy humid primeval forest, surrounding the swamps on the coast of the maar lake. This habitat from the time of secondary maar-filling formation was different from that, which existed there during the formation of primary maar filling, when the eutrophic lake with predominance of unicellular heterotrophic peridinioid dinoflagellates filled the maar.

Evolution of the Hajnáčka palaeoenvironment

Based on long-term researches, a following paleoenvironmental evolution at the site can be recognized. 1. Phreatic explosions formed a dish-like maar depression at the beginning of the Gauss magnetochron C2An, after a termination of the second (5.43 to 3.58 Ma ago) volcanic activity of six phases recognized on a territory of southern Slovakia. The phreatic explosions also ejected a sandy material from disintegrated Eggenburgian sandstones, which accumulated as a layer at the bottom of maar depression. 2. Successive phreatomagmatic eruptions of pyroclastic material formed a tuff ring around the central depression. Gravitational slides, produced by seismic shocks and repeated explosive activity, caused the transportation of tuff material from the inner slopes of the ring to the lower levels of the maar depression. 3. As the phreatomagmatic eruptions ended, the fine laminated sediments accumulated in a central part of the eutrophicated maar lake in which dominated the unicellular heterotrophic peridinioid dinoflagellates. A lake was surrounded by a forest composed of temperate coniferous taxa with sporadic occurrences of angiosperms. They represented a pioneer assemblage growing on the slopes and farther away from the maar lake shores during the warm temperate climate. 4. At approximately 3.3 Ma ago, a tuff ring was partly eroded as a consequence of the Cerová vrchovina Upland updoming. The north-western part of the maar depression was opened and ephemeral streams destroyed and removed the sediments of primary maar filling. In the newly originated lake, which now possessed an inflow and outflow, the secondary maar filling accumulated. At this time (between 3.3 to 2.8 Ma ago), an area around the lake was covered by bushy, humid deciduous to mixed mesophytic forest, with steppe or open grassland areas. Tapirs, mastodons, rhinos and cervids dominated the forest, whereas representatives of hyenas, machairodontines, lagomorphs and some rodent species were present on the warm, open steppe. An extinction of the Hajnáčka fauna and flora was probably caused by the eruption of a nearby volcano and the subsequent volcanic ash falls and/or poisonous gas emissions. 5. During the next period (the third volcanic phase: 2.92 to 2.60 Ma ago), volcanic activity in proximity to the site continued and the entire area was uplifted. The secondary maar filling and its vertebrate skeletons were reworked, most probably by water erosion. 6. Quaternary geological processes (erosion, solifluction and repeated landslides) removed the maar remains and the fossil remnants. Hereby, the maar sediments were again disturbed and partly mixed with the Late Pleistocene sediments.

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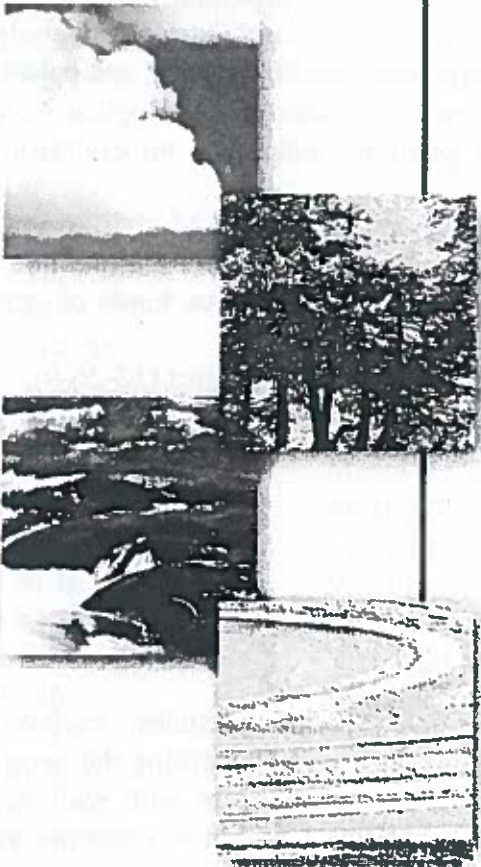
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